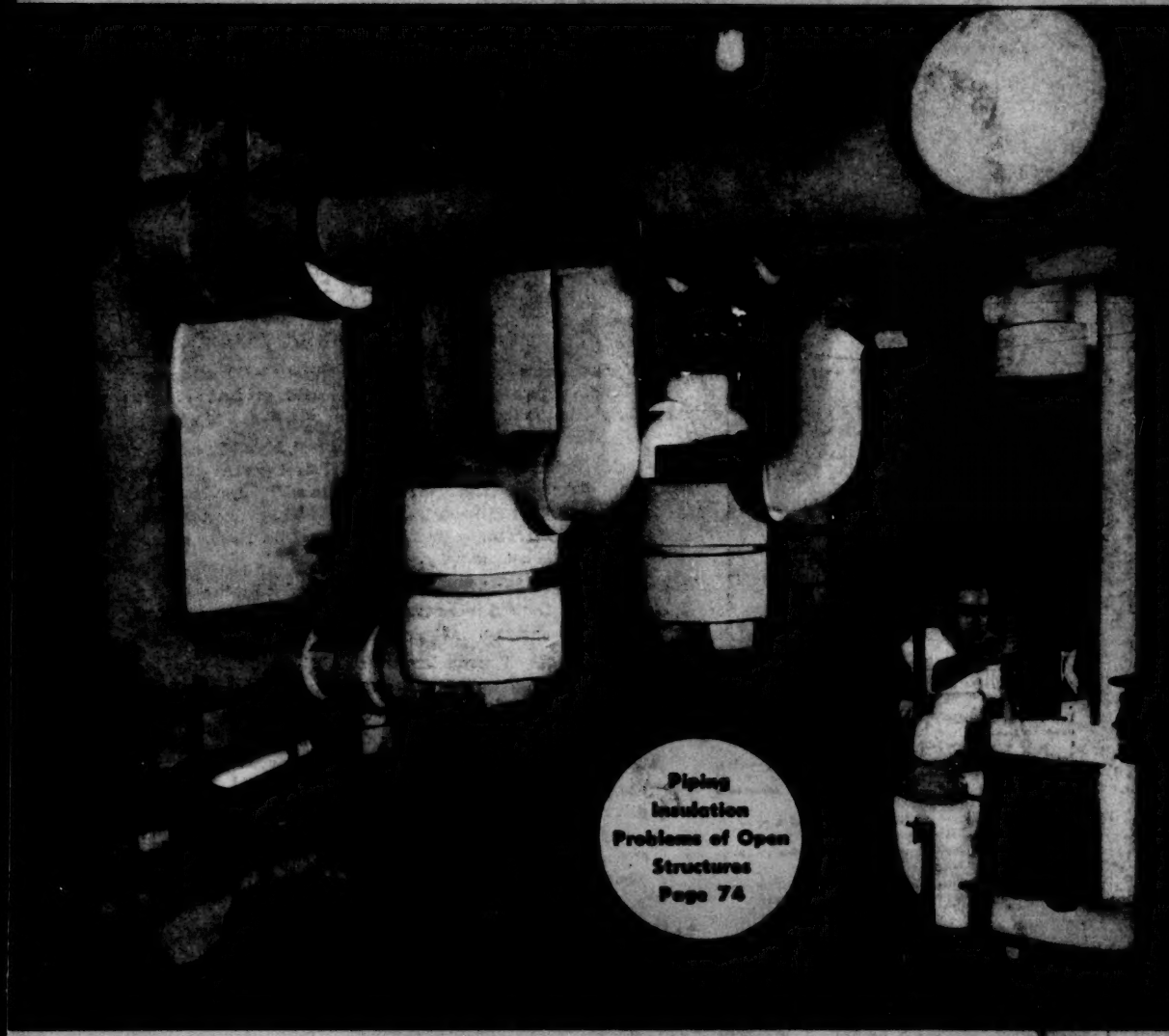
MAY, 1951

HEATING AND VENTILATING

INCLUDING AIR CONDITIONING – PIPING – REFRIGERATION – AIR SANITATION



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Air Conditioning for Residences . page 87

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"HET UP" about YOUR wasteful heating SET UP?

Why not change to

THERMOLIER

UNIT HEATERS

If you're dismayed about *last winter's* high-cost-of-heating, how about next year — when it may be as hard to get *fuel*, as it was for you to get *heat* this year?

Here's a red-hot tip. To save heat and fuel, install Thermolier Unit Heaters. But don't delay. Material shortages can seriously disrupt the production of unit heaters. In addition, skilled men are available to make installations now. They may not be in the days ahead. Study these Thermolier Unit Heater advantages — *and act promptly.*

HEATING COMFORT Thermoliers provide quick heating from a cold start. Desired room temperatures are easily maintained within a close range.

LOW FIRST COST Thermoliers are so efficient and so compact that their heating capacity is often equivalent to the capacity of cast iron radiation or pipe coils of twice the cost.

ECONOMY OF OPERATION Heat is forced down to the working level . . . not banked uselessly at the ceiling level.

ADAPTABILITY TO EQUIPMENT AND FLOOR LAYOUT Thermolier unit heating is widely used in industrial plants and warehouses, garages, stores and public buildings. The units and the simple piping are overhead where they do not interfere with arrangement of the operating machinery or equipment.

THERMOLIER CONSTRUCTION FEATURES THAT SAVE MONEY

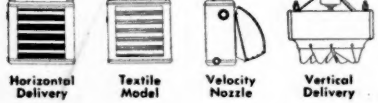
Use of plain thermostatic trap, the simplest and least expensive kind of trap, is practical because of Thermolier's exclusive internal cooling leg.

Maximum capacity provided at all times and annoying, destructive water hammer eliminated by built-in pitch of tubes and internal cooling leg which assures continuous drainage of condensate.

Damaging strains caused by expansion and contraction eliminated by "U" type expansion tubes.

Safety and durability assured with leak-proof tube-to-header construction.

Eight other important features. Write for Thermolier Catalog.



Horizontal Delivery | Textile Model | Velocity Nozzle | Vertical Delivery

GRINNELL

WHENEVER PIPING IS INVOLVED

GRINNELL COMPANY, INC., Providence, R. I. Warehouses: Atlanta • Billings • Buffalo • Charlotte • Chicago Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach • Los Angeles • Milwaukee • Minneapolis • New York Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

Bundyweld Tubing . . . plays double role in better radiant heating

Handles better at your building site, **Performs** better in your systems . . .

Because Bundyweld is better tubing . . . the only tubing that's double-walled from a single strip, with a patented beveled edge. Copper-brazed through 360° of contact, its walls are safe, solid, strong.

Rugged Bundyweld arrives at your building site (one end expanded if specified) ready to ride right through fabrication steps. One man bends dead-soft Bundyweld on a simple fixture, joins the formed, rigid grids in leakproof union by soft or hard soldering. Just two men position them. There's never a worry about dents or structural collapse.

Performance in your systems is just as smooth. For Bundyweld is scale-free. Water flow stays clean, even, steady. Bundyweld's thinner wall radiates heat faster, more effectively, as well.

Check your *Sweet's Architectural File* for more information. Or write: ***Bundy Tubing Company, Detroit 14, Michigan.*** Whatever your needs, we'll do our best for you, with the understanding, of course, that defense orders must come first.

Bundyweld® Tubing

DOUBLE-WALLED FROM A SINGLE STRIP

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of basic metal, coated with a bonding metal. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

passed through a furnace. Bonding metal fuses with basic metal, presto—

Bundyweld . . . double-walled and brazed through 360° of wall contact.

NOTE the exclusive patented Bundyweld beveled edge, which affords a smoother joint, absence of bead and less chance for any leakage.

The Importance of the Revolving Discharge Outlet in the Heating of Industrial Buildings

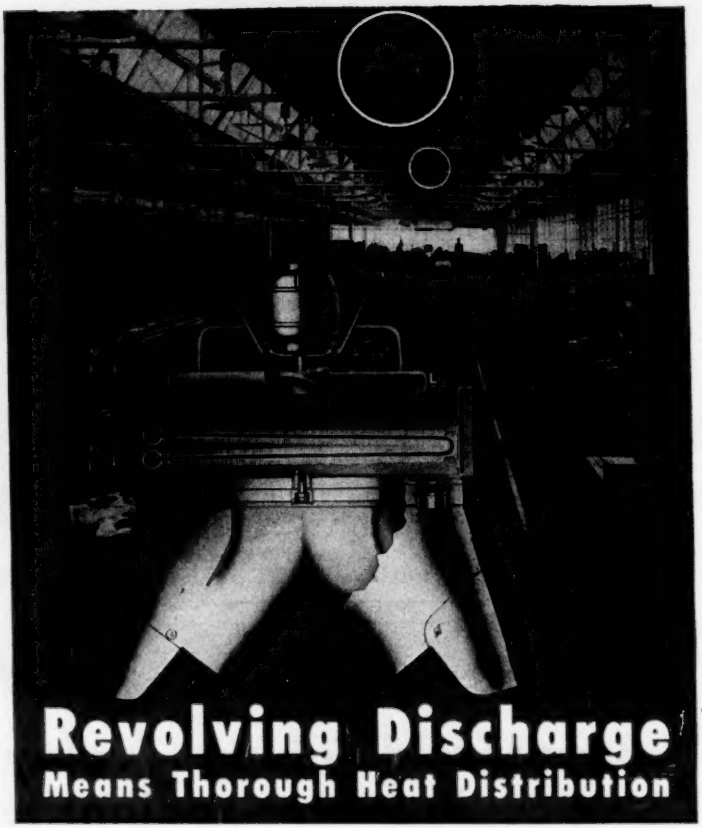
by D. Gilbert

The almost universal use of unit heaters for industrial plant heating indicates a conviction on the part of plant engineers, managers, consulting engineers and architects that this is the most satisfactory way of heating buildings and workrooms. Industry has come a long way, indeed, from the days not too long ago, when pipe coils, suspended from side walls or under windows, were the common means of heating a plant.

But, as pointed out in the article on Unit Heaters in a leading authoritative publication:

"In order to direct the air to points desired, and to diffuse the air to avoid drafts, unit heaters are commonly equipped with directional outlets, adjustable louvers, or fixed types of diffusers. . . . As hot blasts of air in the working zone are usually objectionable, heaters mounted on the floor should have their discharge outlets above the head line, and suspended heaters should be placed in such manner and turned in such direction that the heated air stream will not be objectionable in the working zone."

This is sound advice, but even with such stratagems, it is seldom possible to obtain satisfactory results. The basic difficulty lies in the use of **stationary** discharge outlets. Only one type of unit heater is able to avoid the objectionable "hot blasts" so distressing to workers in fixed positions, as an assembly lines or at machine tools. That is the heater suspended from roof or ceiling in which the downward discharge of heated air is distributed by slowly **revolving** discharge outlets. There are no fixed blasts, no chilly corners untouched by the air streams; just a gentle, thorough movement of the heated air at the working level, over obstacles, around obstructions, moving under tables, benches, truck bodies, airplane wings, even into repair pits. The result is an evenly warmed blanket of air at the working level, a gently moving, invigorating atmosphere that is pleasantly stimulating to the worker and better for his health.



Revolving Discharge
Means Thorough Heat Distribution

There are three types of Wing Revolving Discharge outlets, two of which are shown here. No. 8 for high ceilings is shown in the cross-section. No. 4 for medium heights in the factory scene.

As contrasted with the stationary unit heater, which projects air in one or more fixed directions, the Wing revolving discharge outlets move slowly through a complete circle discharging heated air in constantly changing directions — reaching every inch of plant area with fresh, invigorating warmth. Hot blasts and chilly areas are eliminated, assuring maximum comfort for employees and more production for the plant owner. Write today for Bulletin HR-5 describing in detail how Wing Revolving Heaters can put an end to your plant heating problems.

L. J. Wing Mfg. Co. 158 Vreeland Mills Road, Linden, N. J.
Factories: Linden, N. J. and Montreal, Canada

In Europe: ETABLISSEMENTS WANSON, Haren-Brussels, Belgium

Wing
Revolving
UNIT HEATERS

HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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The Contents of HEATING AND VENTILATING are indexed monthly by Industrial Arts Index and by Engineering Index

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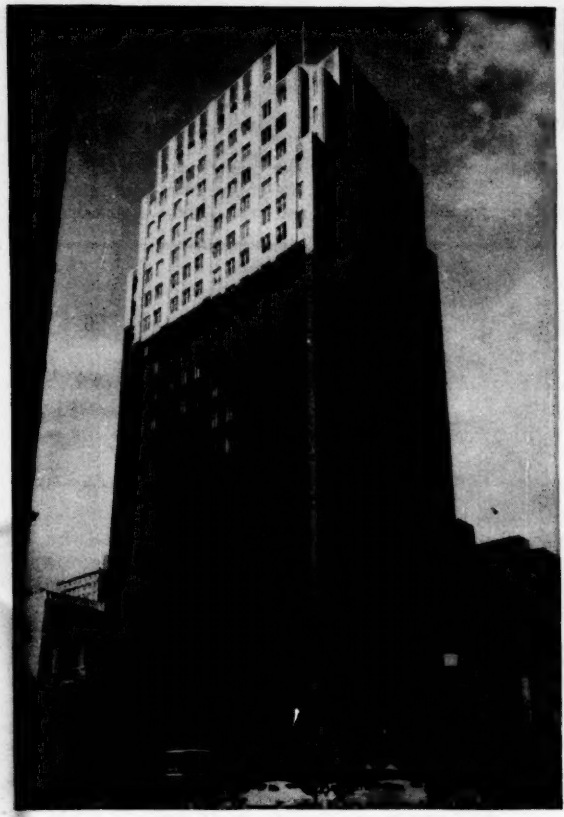
Also Publishers of
HEATING & PLUMBING EQUIPMENT NEWS
and technical books.

THIS MONTH'S COVER

Steam meters and high pressure steam headers in the steam meter room of the New York Port Authority Bus Terminal located in New York City, are insulated with 85% Magnesia and finished with an 8-ounce canvas jacket. For details, see page 74.



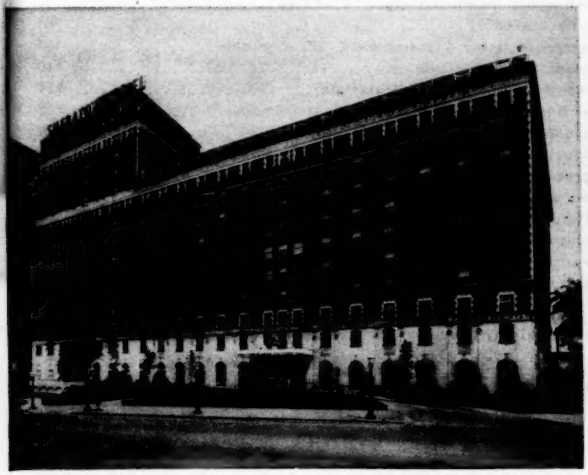
AIR CONDITIONING SYSTEMS

In Houston, St. Louis, New York...

G-E Personal Weather Control

is saving space, cutting cost

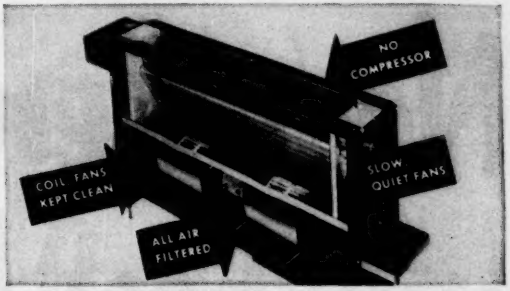
"BEST AIR CONDITIONING JOB in an existing building in Texas," says Paul E. Wise of Houston's Sterling Building, one of many recent G-E Personal Weather Control installations. To save space, particularly important in existing buildings that were not originally designed for air conditioning, small-size, high-pressure ducts were used for ventilation. Consulting engineer: Hollis U. Bible. Air conditioning contractor: Sebastian Air Conditioning Corporation.



SHERATON HOTEL IN ST. LOUIS installed a G-E Personal Weather Control System in 1949. Expressing "complete satisfaction," Sheraton Corporation has since installed these systems in its hotels in many other cities. Units in unoccupied rooms can be shut off, saving power cost. They filter air, keeping coils clean and at top efficiency. Air conditioning contractor: Natkin and Company.

LUXURIOUSAPARTMENTS now being built at Sutton Place South, 53-54 Sts., New York City, will give tenants individual climate control with over 1200 G-E room units. General contractor: Paul Tishman Company, Inc. Architect: Arthur Weiser. Consulting engineer: Rutherford L. Stinard. Air conditioning contractor: Raisler Corp.

COMPACT, 9-INCH DEEP UNITS in each room take little space, yet circulate air gently through large area. Units are supplied with attractive cabinets (above) or without cabinets for concealed applications. Simple pipe runs circulate chilled water for summer air conditioning, hot water for winter heating. Windows are never blocked.



EXTRA-EFFICIENT, QUIETER! G. E.'s room units filter all air, protecting coils from dust and dirt which cut efficiency drastically. Filter replacement takes less than a minute—it's much simpler and cheaper than costly coil cleaning. G-E units are quiet! There's no compressor in the room unit, just the quiet G-E motor and velvet-smooth, low-speed fans.

Consider how G-E Air Conditioning can make your building more profitable

Because space means money in both new and existing buildings, General Electric Personal Weather Control Systems have been designed for installation with small-size, space-saving ducts or no ducts at all.

These extremely flexible systems heat in winter and cool in summer. Individual room air conditioners (shown above) are supplied with chilled or hot water through simple pipe runs from a central source.

In new buildings, such as the apartments at Sutton Place South, 53-54 Sts., (at left) New York, the use of wall apertures for ventilation eliminates the need for ductwork and cuts installation cost. In existing buildings such as Houston's Sterling Building and the Hotel Sheraton in St. Louis, adaptability of ventilation methods to individual needs avoids the necessity of building alterations.

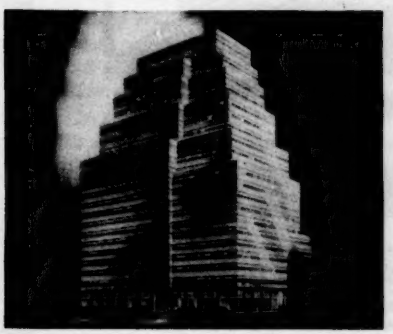
Flexibility Means Economy...Future space rearrangement is simplified by the use of G-E room units because of their flexibility in capacity. G-E Air Conditioning pays off in operating cost reduction, too. During periods of system start-up or reduced occupancy, the room units can be operated without the expense of running central ventilation equipment. Units in unoccupied rooms can be shut off. G-E systems often require less compressor capacity, saving both installed and operating cost.

Building Value Increases...Tenants enjoy living or working where they get individual finger-tip control of climate without disturbing other rooms. Greater tenant satisfaction means lower turnover, more profitable occupancy.

Cuts Maintenance Cost..."Never had to replace one," says Clay J. Berry of the Fair Building, Fort Worth, Texas, where 500 G-E room units have been in use since 1939.

"Maintenance cost has been no factor, and operating cost has been surprisingly low," says E. F. Puls, National City Building, Dallas, Texas.

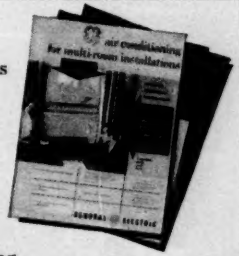
Owner satisfaction like this is one of the reasons why G-E Personal Weather Control is going into buildings like New York's new Dun and Bradstreet Building...12 Sheraton Hotels...and banks, hospitals, and other structures in many parts of the country.



NEW G-E CENTRAL PLANT SYSTEM for New York City building. The beautiful new 25-story office building at 575 Madison Avenue uses 43 G-E large-space air conditioners. To save ductwork, units are installed on all floors. General contractor: Uris Brothers. Architect: Emery Roth & Sons. Consulting engineer: Rutherford L. Stinard. Air conditioning contractor: Raisler Corp.

See our catalog in Sweet's

FREE! Data on G-E Air Conditioning Systems



- **GENERAL ELECTRIC COMPANY, Air Conditioning Department, Sec. HV-8, Bloomfield, N. J.**

Please send me without obligation detailed information on

☐ G-E Personal Weather Control

☐ G-E Central Plant Air Conditioning

NAME.....

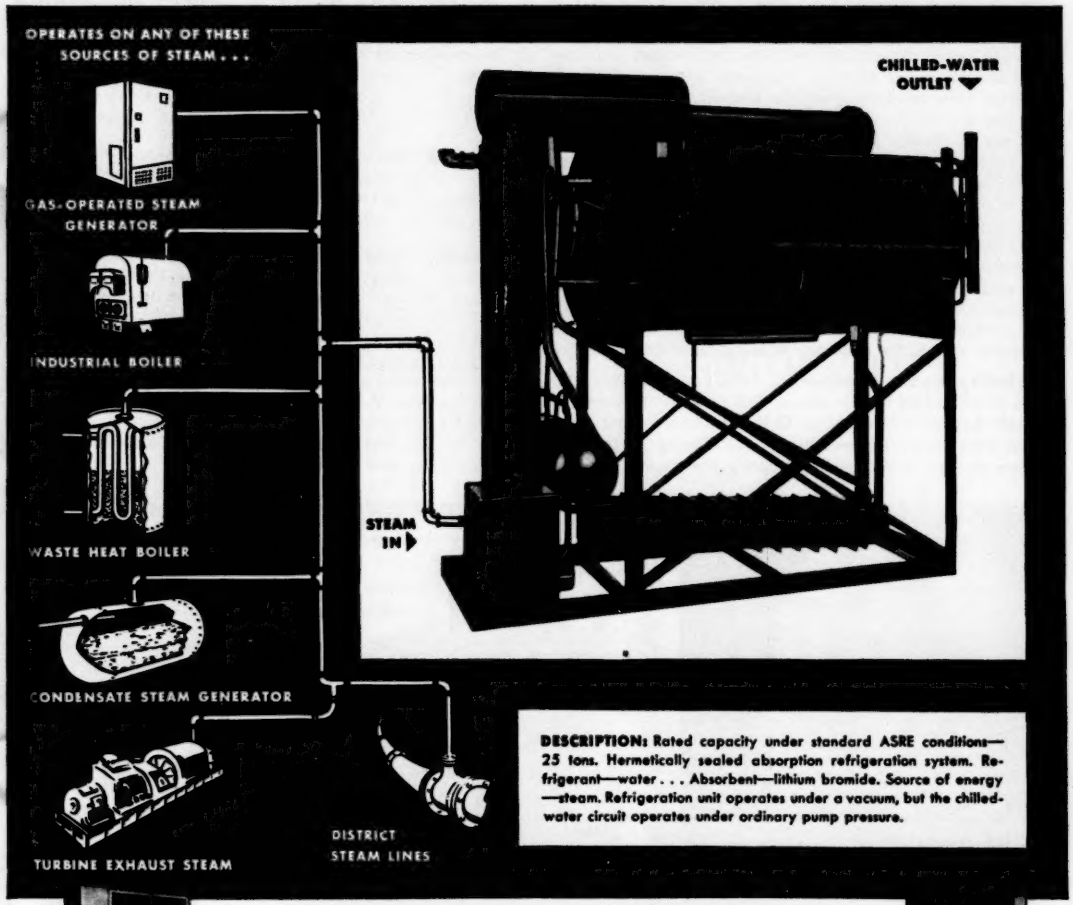
COMPANY.....

ADDRESS.....

CITY.....STATE.....

GENERAL ELECTRIC

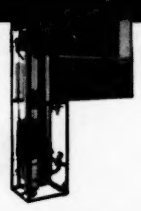
New Servel Water new horizons in


OPERATES ON ANY OF THESE SOURCES OF STEAM . . .
GAS-OPERATED STEAM GENERATOR
INDUSTRIAL BOILER
WASTE HEAT BOILER
CONDENSATE STEAM GENERATOR
TURBINE EXHAUST STEAM
DISTRICT STEAM LINES
CHILLED-WATER OUTLET
STEAM IN
DESCRIPTION: Rated capacity under standard ASRE conditions—25 tons. Hermetically sealed absorption refrigeration system. Refrigerant—water . . . Absorbent—lithium bromide. Source of energy—steam. Refrigeration unit operates under a vacuum, but the chilled-water circuit operates under ordinary pump pressure.

SERVEL STEAM-OPERATED AIR CONDITIONERS

Self-Contained Unit. 5 tons of refrigeration. Heating optional.

Absorption Refrigeration Unit. In 3- and 5-ton sizes. For single or multiple installations.



Chiller opens application flexibility

25-Ton Servel Absorption Unit Provides Long-Life Refrigeration from Inexpensive Steam

The application flexibility of this new Servel Water Chiller makes it an economical source of chilled water for most applications. These points show how easily it will fit your requirements:

NUMEROUS USES—Comfort air conditioning . . . industrial temperature and humidity control . . . precooling for air compressors and internal combustion engines . . . chilled water for manufacturing processes . . . and many others.

STEAM OPERATION—Use the cheapest source of steam . . . any pressure will do. Use the cheapest fuel to make steam—waste heat or manufacturing by-products if available . . . or waste steam.

SIMPLE INSTALLATION on any floor from basement to penthouse . . . in multiple or single installations . . . low floor loading . . . no vibration . . . quiet operation.

MODULATION—Use simple steam controls to reduce capacity of the Servel unit as much as 50% . . . with no appreciable loss of efficiency.

In addition to these important flexibility factors, the new Servel Water Chiller also offers the famous Servel no-moving-parts freezing system. This insures dependable operation, long life, and low maintenance. Add this advantage to its numerous uses, its steam operation, simple installation and capacity modulation, and you'll choose the new Servel Water Chiller* every time.

Mail coupon now, for complete information.

*NOTE: The nation's present need for critical materials limits the availability of the Servel Water Chiller to defense orders at present. However, the Servel equipment shown at the bottom of the opposite page is available without priorities.

HERE ARE SOME REASONS WHY SERVEL IS YOUR BEST AIR CONDITIONING BUY

- No Moving Parts to Wear
- Low Maintenance Costs
- Hermetically Sealed Circuits
- Long Life
- Complete Safety of Operation
- Chilled Water Circuit Operates Under Normal Pump Pressure

SEND COUPON FOR MORE INFORMATION

Servel

EVANSVILLE 20, INDIANA

WATER HEATERS **AIR CONDITIONING**
HOUSEHOLD REFRIGERATORS

Servel, Inc.
Department T-25, Evansville 20, Indiana

Gentlemen:

Please send me more information on the following:

Servel 25-Ton Water Chiller_____
Servel Self-Contained Air Conditioner_____
Servel 3- and 5-Ton Refrigeration Units_____

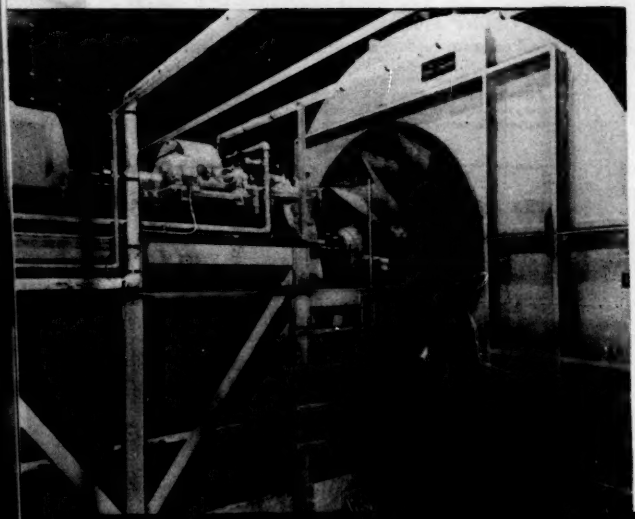
*Name*_____

*Firm*_____

*Address*_____

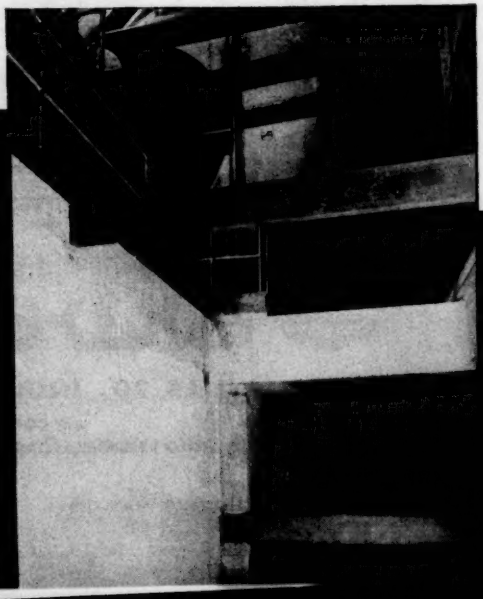
GIVE AIR A *Fast*

— as KAUFMANN'S SHOPPERS ENJOY "RESORT" CLIMATE IN ALL 13 STORIES OF PROMINENT PITTSBURGH STORE



DELIVERING 15 TONS OF AIR EVERY MINUTE!

The first air conditioning installation utilizing the high duct velocity principle for large interiors. More air thru smaller ducts at faster speeds saves space and money. Designed and installed by The Carrier Corporation, this installation is already highly regarded in the department store field.



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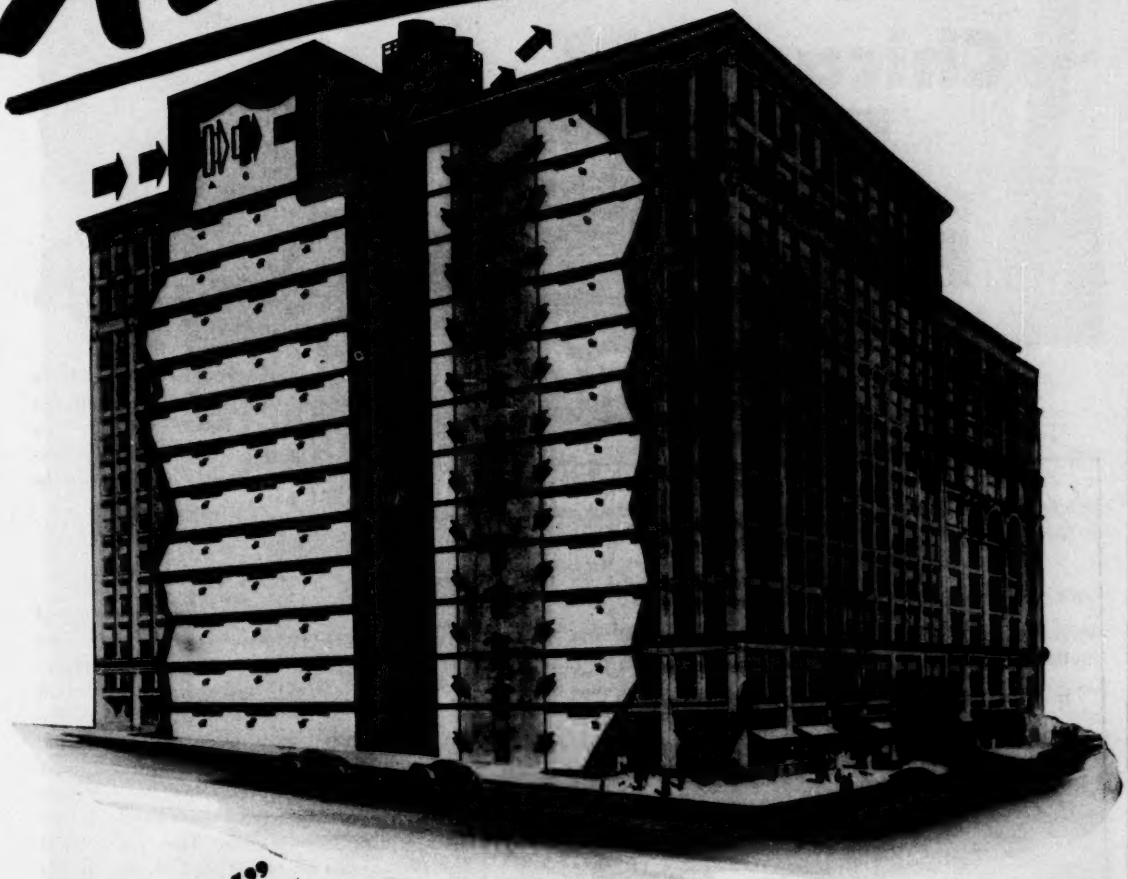
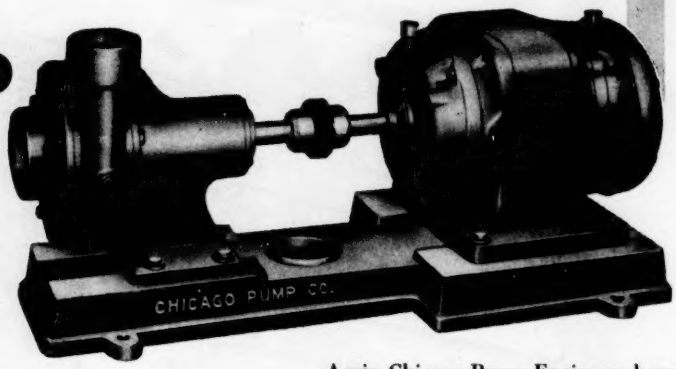


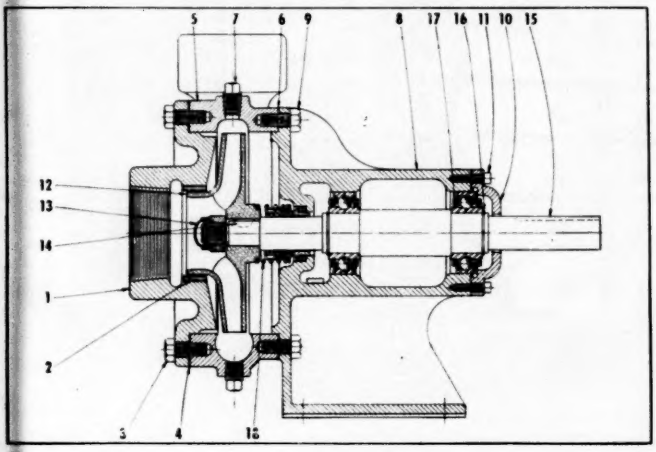
"Buffalo" CAN SOLVE YOUR AIR PROBLEM!

Now a Chicago Pedestal Mounted Side Suction Pump is Available . . .

Chicago B PUMP



Again Chicago Pump Engineers have produced a fine pump. The Chicago B Pump is pedestal mounted, side suction, and is driven through a flexible coupling. Here is a quality pump ruggedly built.



No.	Description	No.	Description
1	Suction Cover	10	Bearing Cap
2	Wearing Ring	11	Socket Hd. Cap Screw
3	Hex. Hd. Cap Screw	12	Impeller
4	Gasket	13	Elastic Cap Stop Nut
5	Volute Casing	14	Woodruff Key
6	Gasket	15	Shaft
7	Pipe Plug	16	Retaining Ring
8	Bearing Bracket	17	Sealed Ball Bearing
9	Hex. Hd. Cap Screw	18	Precision Shaft Seal

MECHANICAL DESCRIPTION

A bronze enclosed impeller is keyed to a sturdy stainless steel shaft. Two heavy duty ball bearings support the shaft. These bearings are lubricated for life. A mechanical seal provides positive insurance against leaking. Pipe discharge sizes are 1¼", 2" and 3". The 3" pump has flanged pipe connections. All others have screwed pipe connections. The pump will handle up to 500 G.P.M. and heads up to 215 feet.

SHAFT SEAL Precision built of brass, stainless steel, and neoprene, this high quality mechanical seal insures against leaking. The seal automatically compensates for normal wear on the sealing surfaces. Shaft wear and scoring is eliminated—no maintenance or adjustment is necessary. No expensive piping is needed from drip pocket to drain. No messy floors.

Write for Bulletin 107

CHICAGO PUMP COMPANY

BUILDING and INDUSTRIAL DIVISION

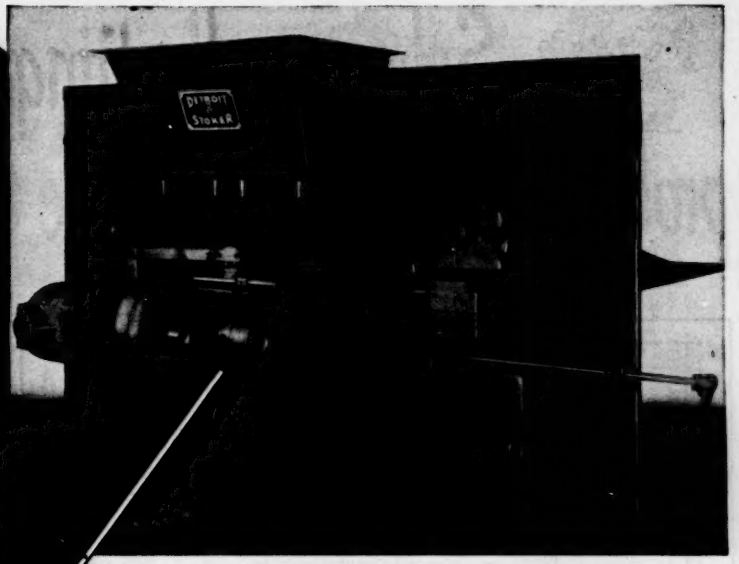
2300 WOLFRAM STREET — **CHICAGO 18, ILLINOIS**

Condo-Vac, Sure Return, AVC, LVC, Fire, House & Circulating Pumps
Pneumatic & Tankless Water Systems

Flush-Kleen Sewage Ejectors
Little Giant & Non-Clog Bilge Pumps
Pumps for every industrial use.

Detroit Double Retort Stoker

now available with



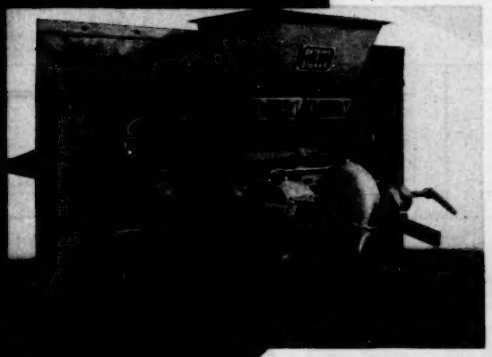
ADJUSTABLE FEED

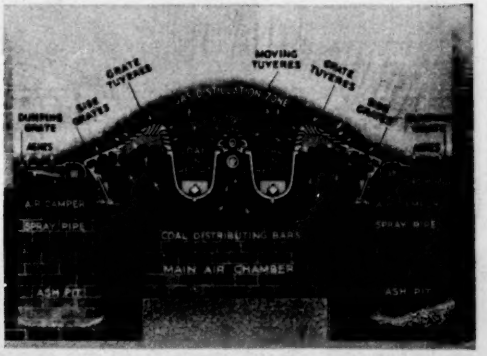
Provides a wide variation in fuel supply to the retorts and is now available with Detroit Double Retort Stokers.

When coupled to a master regulator, which also varies the air supply, the adjustable feed provides fully automatic control of fuel and air. Higher thermal efficiencies at all capacities.

For Many Boilers—Two Retorts Are Better Than One

The Detroit Double Retort Stoker is a multiple retort stoker with two retorts, having the *side cleaning* feature. Provides high efficiency with boilers of medium capacity. Adjustable, continuous sideward movement of the center row of tuyeres is an exclusive feature that gives positive movement of the burning fuel toward the dumping grates. • Write for recommendations.



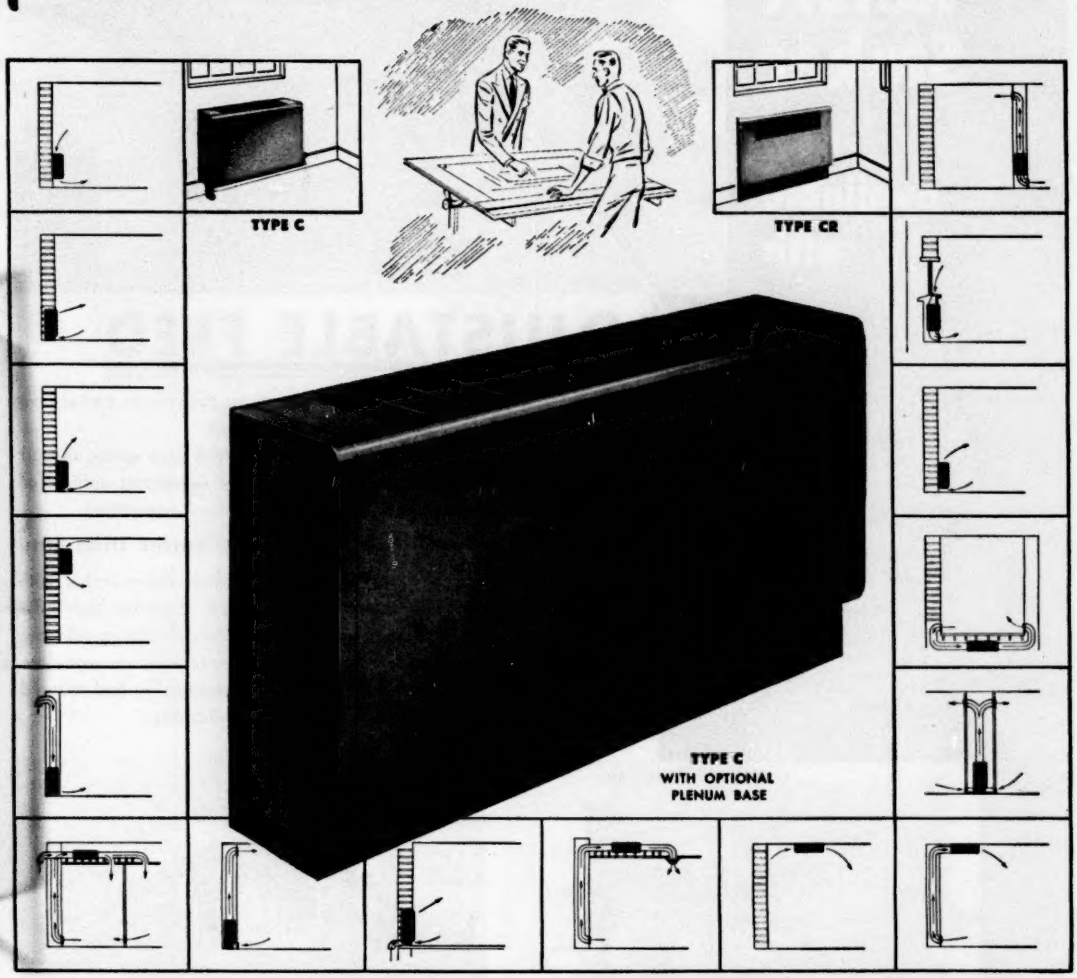


DETROIT STOKER COMPANY

General Motors Building — Detroit 2, Michigan

District Offices in Principal Cities • Works at Monroe, Michigan

Solve your heating and cooling problems with new Modine Cabinet Units



Whatever your heating and cooling problems — there's a new Modine Cabinet Unit to fit your needs. A single unit for forced hot water heating, chilled water cooling. Steam models for heating only. Smartly designed and easy to clean and service. Quiet operation and quick response make Modines ideal for modern commercial and public buildings. Two basic types in five sizes . . . with optional equipment for meeting a wide range of application requirements.

WRITE FOR NEW BULLETIN 550 TODAY! *Your Modine representative is listed in the classified section of your phone book. Or write Modine Mfg. Co., 1511 Dekoven Ave., Racine, Wis.*

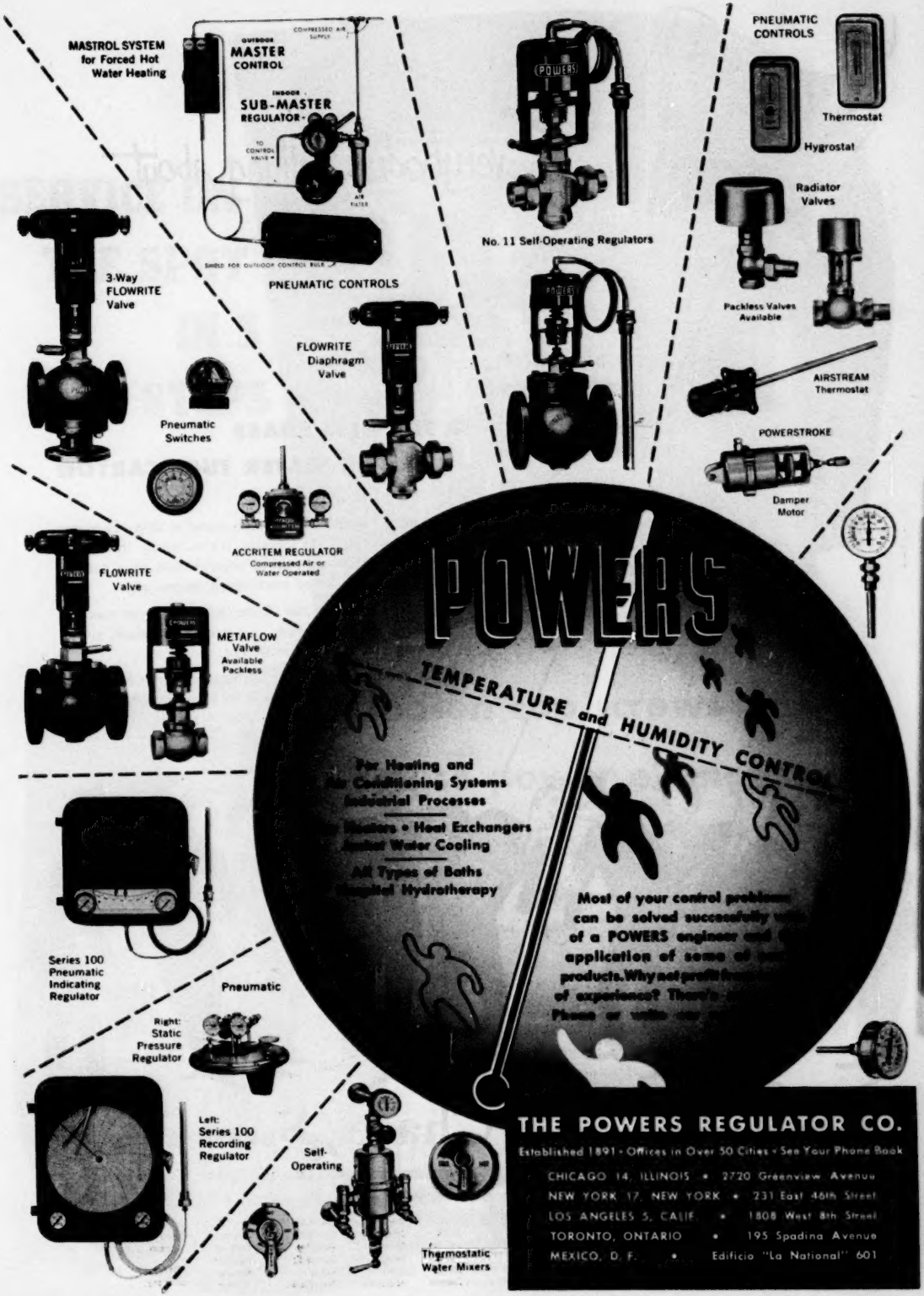
Modine

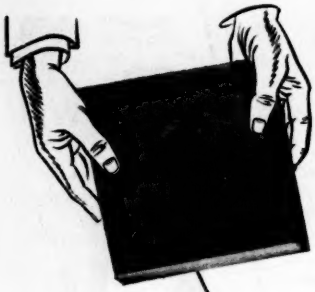
CABINET UNITS

FOR HEATING & COOLING

U-1087

LUTZ


MASTROL SYSTEM for Forced Hot Water Heating
MASTER CONTROL
SUB-MASTER REGULATOR
PNEUMATIC CONTROLS
No. 11 Self-Operating Regulators
PNEUMATIC CONTROLS
Thermostat
Hygrostat
Radiator Valves
Packless Valves Available
3-Way FLOWRITE Valve
FLOWRITE Diaphragm Valve
Pneumatic Switches
AIRSTREAM Thermostat
POWERSTROKE
Damper Motor
ACCRITEM REGULATOR
Compressed Air or Water Operated
FLOWRITE Valve
METAFLOW Valve
Available Packless
POWERS
TEMPERATURE and HUMIDITY CONTROL
For Heating and Air Conditioning Systems Industrial Processes
Heaters • Heat Exchangers Jacket Water Cooling
All Types of Baths Hospital Hydrotherapy
Most of your control problems can be solved successfully with the help of a POWERS engineer and the application of some of our products. Why not profit from his years of experience? There's a Phone or write our
Series 100 Pneumatic Indicating Regulator
Pneumatic
Right: Static Pressure Regulator
Left: Series 100 Recording Regulator
Self-Operating
Thermostatic Water Mixers
THE POWERS REGULATOR CO.
Established 1891 - Offices in Over 50 Cities - See Your Phone Book
CHICAGO 14, ILLINOIS • 2720 Greenview Avenue
NEW YORK 17, NEW YORK • 231 East 46th Street
LOS ANGELES 5, CALIF. • 1808 West 8th Street
TORONTO, ONTARIO • 195 Spadina Avenue
MEXICO, D. F. • Edificio "La National" 601



Everybody's talking about

● THE NEW CHASE COPPER WATER TUBE CARTON

And no wonder! It's so convenient to ship . . . to use . . . to store . . to identify. It's so sturdy that many sizes of tubes are packed several coils to a carton. That means a lot of steps saved on the job.

Chase Copper Water Tube is uniform in temper, making it easy to bend . . . corrosion resistant, giving it long life. It's light in weight, too.

For good, pressure tight connections with Chase Copper Water Tube, use Chase Solder-Joint Fittings.

Chase BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

• *The Nation's Headquarters for Brass & Copper*

Albany†	Cleveland	Kansas City, Mo.	New York	San Francisco
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
Baltimore	Denver†	Milwaukee	Pittsburgh	Waterbury
Boston	Detroit	Minneapolis	Providence	(†sales office only)
Chicago	Houston†	Newark	Rochester†	
Cincinnati	Indianapolis	New Orleans	St. Louis	

SERVICE ON THE SPOT IN 3 EASY STEPS

loosen cap screws

raise power element

lift out cage

Now the valve is ready for cleaning or repair without removing it from the line. If you want to change capacity, just change the cage.

EASY—ISN'T IT!

This simplified construction also reduces friction — gives faster valve action. All internal parts are made of corrosion-resistant brass or stainless steel. For "Freon 12," "Freon-22," Methyl Chloride.

For further details, write for Bulletin 171.

See your ALCO wholesaler

ALCO VALVE CO.

859 KINGSLAND AVE • ST LOUIS 5 MO

3629

Designers and Manufacturers of Thermostatic Expansion Valves Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

How good a waiter are you?

Do you burn up when the wife keeps you waiting? Do you pace the floor when the whole job waits on one valve? Then, listen.

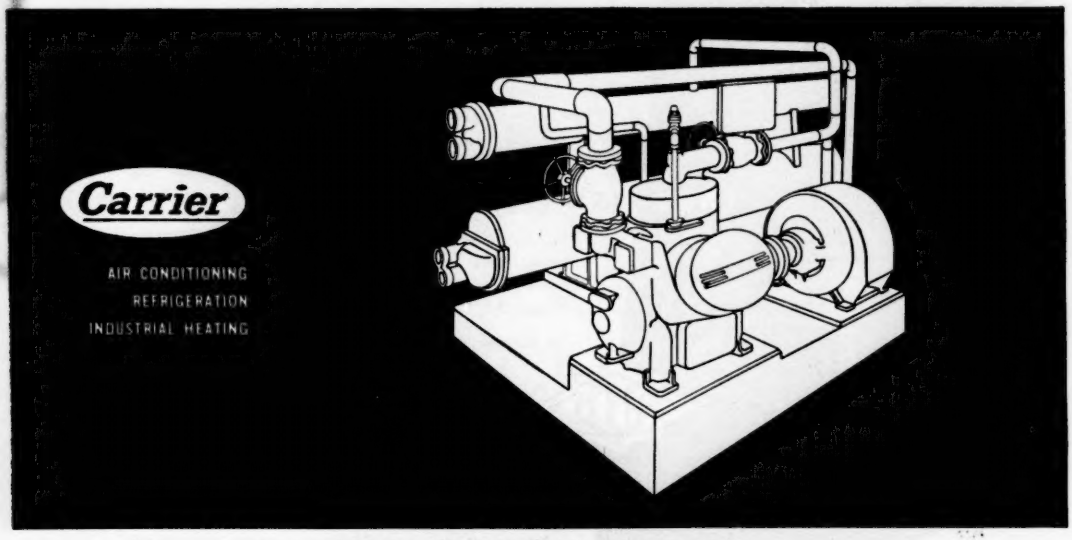
We've got a machine . . . a refrigerating machine. It's the Carrier 100 and 150 hp. Reciprocating Refrigerating Machine. And it's a complete refrigeration system for cooling water or brine . . . for air conditioning or industrial processes.

You get a compressor, a cooler, a condenser, precut piping, valves, control panel, selective fittings, cooler and condenser stands, heat exchanger, foundation drawings, and foundation bolts and sleeves.

So instead of specifying a lot of nuts and bolts, you specify "30B4" or "30B6."

And, instead of waiting for someone to send you this, and someone to send you that . . . and winding up waiting, you get everything at one time from us.

Sound good? There's more. The Carrier Reciprocating Refrigerating Machine costs less than if you assembled your own. And, oh yes, it's a lot better machine. It's factory engineered—and we stand behind it. A little booklet has the full facts. Write for it. Carrier Corporation, Syracuse 1, New York.



The Carrier Reciprocating Refrigerating Machine is adaptable to electric motor, gas or diesel engine and steam turbine drive.

Pack this ADSCO joint at full line pressure!

Special Piston Rings HOLD line pressure during packing operations

Production is reaching for an all-time high. Costly service interruptions and resulting operational losses must be eliminated! One major cause of down time... cutting off service to repack pipe line expansion joints... *can* be completely eliminated. ADSCO Piston-Ring Expansion Joints can be packed *under full line pressure* with no interruption of service.

ADSCO's patented piston-ring feature... with combined internal guide... holds the line pressure even when the packing is completely removed. Venting the relief chamber exhausts any accumulated steam that may have passed the rings and, with no pressure against the stuffing box, all packing may be withdrawn.

Exclusive ADSCO engineering features assure long life and reliable performance in handling high pressures and temperatures. Scratching of the slip and scoring of the packing... major sources of trouble and high maintenance cost... are prevented by ADSCO design. The slip itself is in contact *only* with the packing and complete guiding ensures true movement of the slip without binding.

ADSCO Piston-Ring Expansion Joints are available in a full range of sizes, in both single and double units, with 4", 8" or 12" traverse per slip, for pressures to 400 psi and greater, and for temperatures to 750 F. and higher. For additional information, see your nearest ADSCO representative or *write for Bulletin No. V-35-15.*

ADSCO'S EXTRA FEATURES

- **NO SCORING OF SLIP** because it is in contact only with the packing. The piston rings ride the machined bore of the body.
- **COMPLETE GUIDING** both internally and externally to prevent misalignment.
- **SPLIT EXTERNAL GUIDE** permits installation in smaller spaces.
- **LIMIT STOPS** prevent over-travel. The slip cannot be pulled from the body while in operation.
- **PACKING LUBRICATION** is provided to prolong packing life and ensure smooth performance of the slip.
- **NON-FREEZING GLAND STUDS AND BOLTS** are of non-corrosive metal and always accessible through special openings in the external guide.

For an impartial recommendation, ask the company that makes all types of expansion joints... both slip and packless...

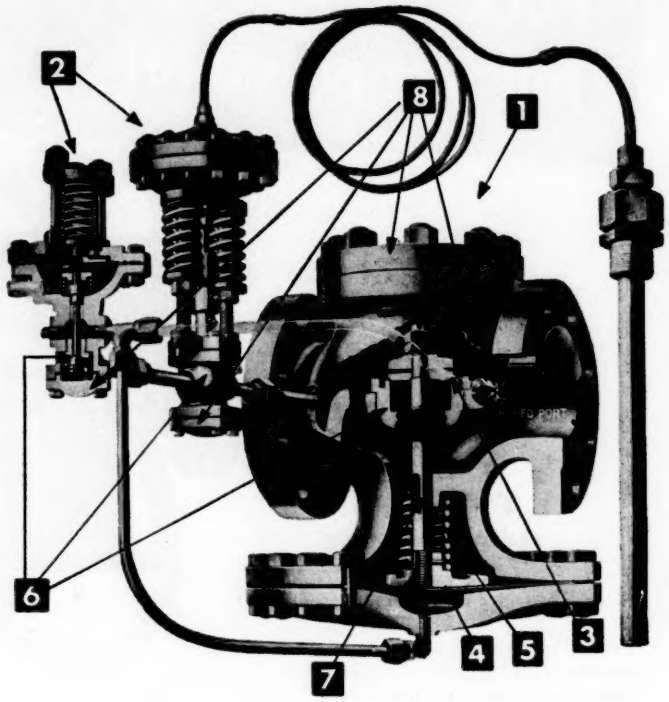
ASK ADSCO

AMERICAN DISTRICT STEAM COMPANY, INC. ★ North Tonawanda, N.Y.

NOW! CUT COSTS OF PRESSURE

These SPENCE features *show you how:*

YOU SAVE MONEY with Spence Self-Operated Regulators because they function dependably and accurately year after year *without requiring extensive repairs or special attention.* This long trouble-free life means less down-time of the system, less time and money wasted on replacement of parts. Thus, you lower over-all costs and, at the same time, are assured of quality performance.



The cutaway illustration above shows why Spence Regulators . . .

REGULATE ACCURATELY

1 The single-seated *packless* main valve is actuated by a large balanced diaphragm. The construction eliminates the need for closely fitted parts which may stick or bind due to uneven expansion or foreign matter.

2 One or more sensitive pressure or temperature pilots control the main valve.

Because the Spence design minimizes friction, accurate regulation remains unaffected by changes in service conditions or length of service.

STAY ON THE JOB FOR YEARS

3 SECO Metal Seats and Discs resist wiredrawing. More than 20 years of experience with SECO Metal in thousands of installations has failed to produce one single case where SECO Metal has been cut by steam.

4 Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

5 The spring in the Spence Regulator is out of the path of the fluid flowing through the valve. It operates at low unit stress to assure performance over an unusually long life.

REDUCE MAINTENANCE

6 The seat and disc of the main valve and pilot can be cleaned and any working part removed, without taking the main valve out of the line.

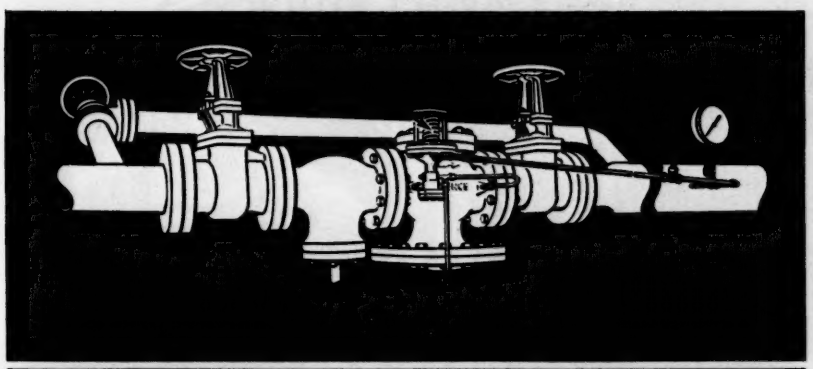
7 All main valves and most pilots are built without stuffing boxes. This packless construction eliminates much time-consuming maintenance.

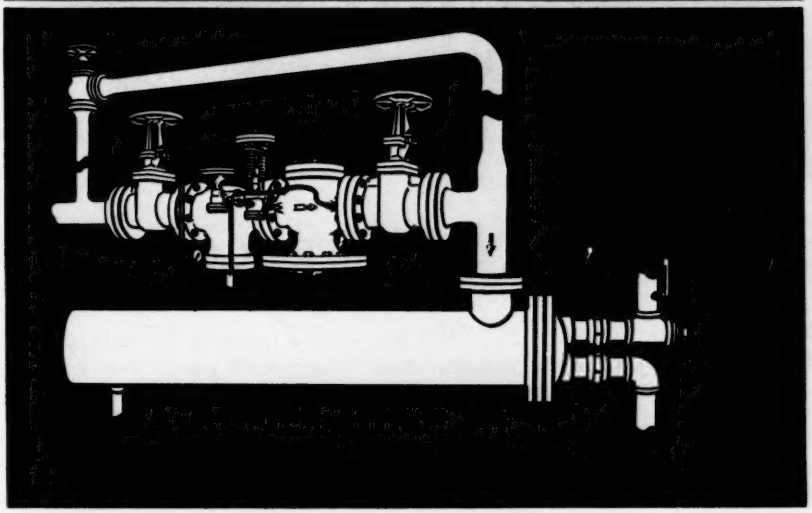
8 No dismantling is necessary to inspect the main valve disc, the pilot valve member and the SECO Metal bleedport. Special openings are provided. Inspection is easier, too, because the pilot is not an integral part of the main valve.

SPENCE ENGINEERING COMPANY, INC.

AND TEMPERATURE CONTROL

TYPICAL INSTALLATIONS





HAVE UNUSUAL VERSATILITY

9 The Spence Regulator, due to its unique design, will serve many functions and will handle all the various types of fluids under a wide range of service conditions. One of the great advantages of this Spence design is the interchangeability of all pilots on all sizes of main valves. Any main valve can be changed from a pressure to a temperature regulator or vice versa *simply by substituting one type of pilot for another.*

Spence Regulators are built in sizes from 1/4" to 12" for service with air, steam, water, oil or gas. With minor adjustments, any Spence Regulator can be easily switched from one service to another.

FREE BULLETIN gives complete engineering details and selection data. It features a full color, fully illustrated description of the operating cycle of a Spence Regulator. Send for your copy of this valuable bulletin today.

9

TYPICAL PRESSURE PILOT MODIFICATIONS AVAILABLE

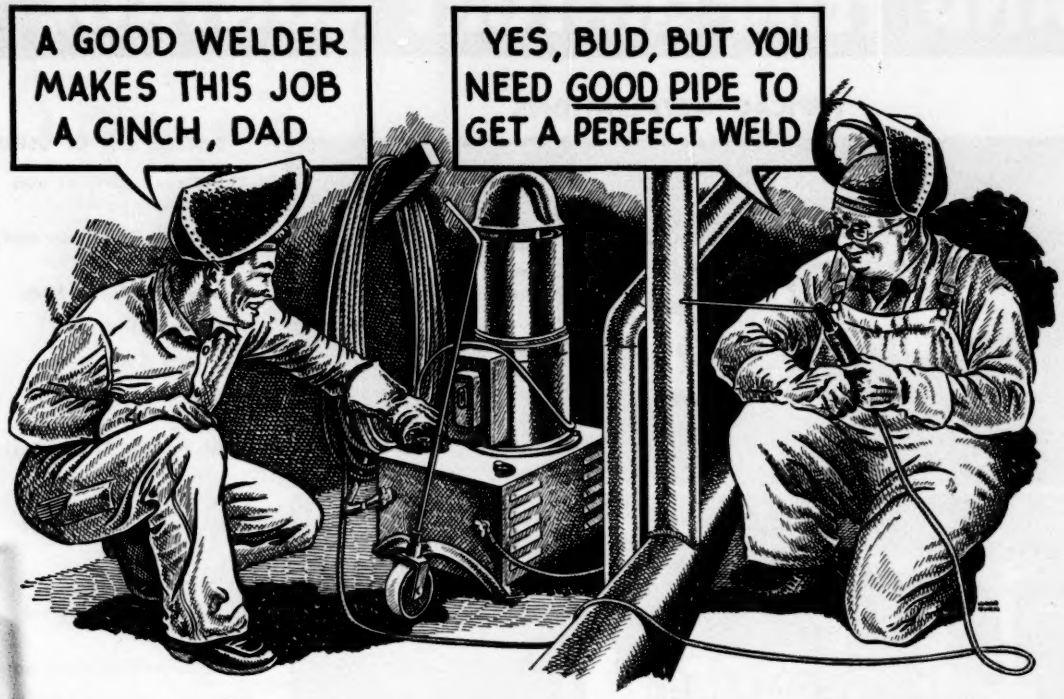
Type	Delivery Pressure Range, PSI	Normal Accuracy + or −
D	3-150	1 PSI
D5	1-25	½ PSI
W	0-10	¼ PSI
W7	0-3	½ OZ

PARTIAL LIST OF USERS

- The Cleveland-Cliffs Iron Company
- Tennessee Coal, Iron and Railroad Company
- The Springs Cotton Mills
- Ford Motor Company
- Cochrane Corporation
- Philadelphia Electric Company
- Pennsylvania Power & Light Company
- L. H. Gilmer Company Div. of United States Rubber Co.
- York Corporation
- Jones & Laughlin Steel Corporation
- The Duluth Steam Corporation
- Rochester Gas and Electric Corporation
- Consolidated Gas Electric Light and Power Company of Baltimore
- Phenix Natural Gas Company
- Cutter Laboratories
- National Tube Company
- The Atlantic Refining Company
- Great Lakes Steel Corporation
- Union Electric Company of Missouri
- Todd Shipyards Corporation
- Oxford Miami Paper Company
- Land O'Lakes Creameries, Inc.
- Ohio Edison Company
- General Electric Company
- R. J. Reynolds Tobacco Company

Spence

WALDEN, NEW YORK



Good welder + good machine + GOOD PIPE = GOOD JOB!

7 POINTS OF UNIFORM GOODNESS IN YOUNGSTOWN STEEL PIPE

- uniform ductility
- uniform lengths
- uniform threading
- uniform weldability
- uniform wall thickness and size
- uniform strength and toughness
- uniform roundness and straightness

No matter how intricate the weld, you do it readily with Youngstown pipe. That's because Youngstown pipe is designed and made for easy welding--truly round, uniform in wall thickness, uniformly sized, and chemically and metallurgically right. The name "Youngstown" rolled into a length of pipe means it is GOOD PIPE.

QUALITY · YOUNGSTOWN · SERVICE

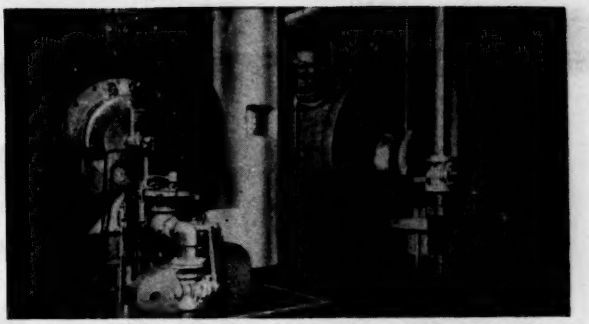
Youngstown STEEL PIPE

THE YOUNGSTOWN SHEET AND TUBE COMPANY · General Offices — Youngstown 1, Ohio

Manufacturers of Carbon, Alloy and Yoloy Steel · Export Office - 500 Fifth Avenue, New York

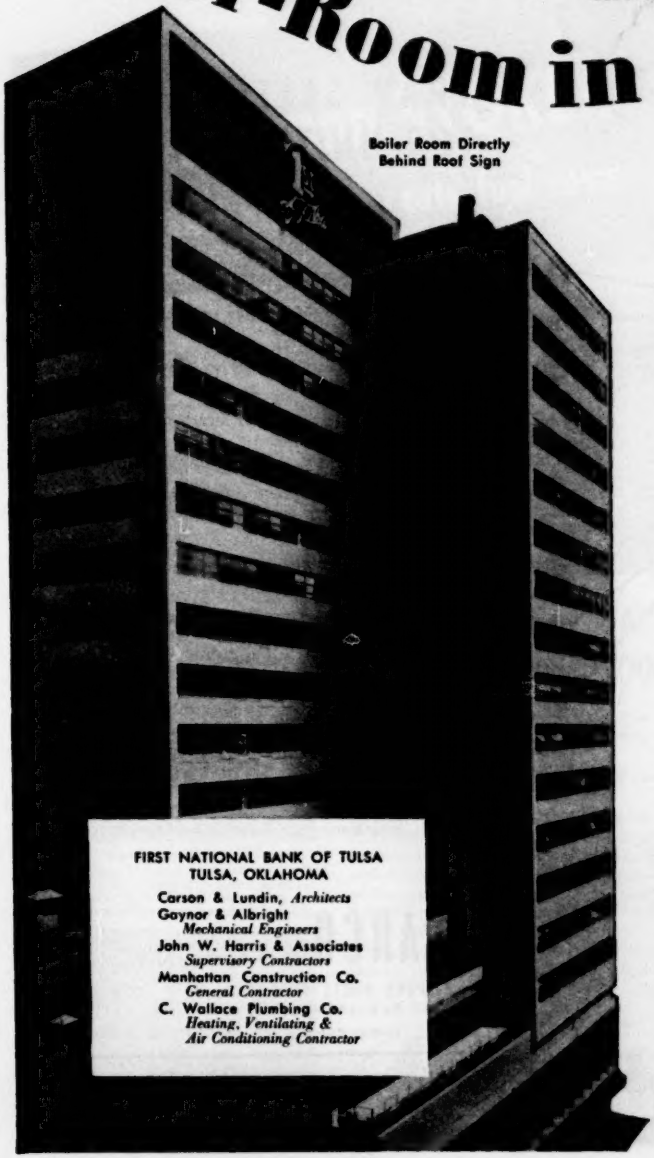
PIPE AND TUBULAR PRODUCTS · WIRE · ELECTROLYTIC TIN PLATE · COKE TIN PLATE · HOT AND COLD FINISHED CARBON AND ALLOY BARS · RODS · SHEETS · PLATES · CONDUIT · RAILROAD TRACK SPIKES

"The Boiler-Room? — On the Roof, Sir"



The "First of Tulsa" Boiler Room — Two Cleaver-Brooks 200 hp. Gas Fired Boilers

Boiler-Room in the SKY..



Boiler Room Directly Behind Roof Sign

FIRST NATIONAL BANK OF TULSA
TULSA, OKLAHOMA

Carson & Lundin, *Architects*
Gaynor & Albright
Mechanical Engineers
John W. Harris & Associates
Supervisory Contractors
Manhattan Construction Co.
General Contractor
C. Wallace Plumbing Co.
Heating, Ventilating & Air Conditioning Contractor

FURTHER PROOF OF CLEAVER-BROOKS BOILER FLEXIBILITY

The new $6,000,000 First National Bank of Tulsa, one of the finest buildings in the Southwest, is heated with Cleaver-Brooks Self-Contained Steam Boilers.

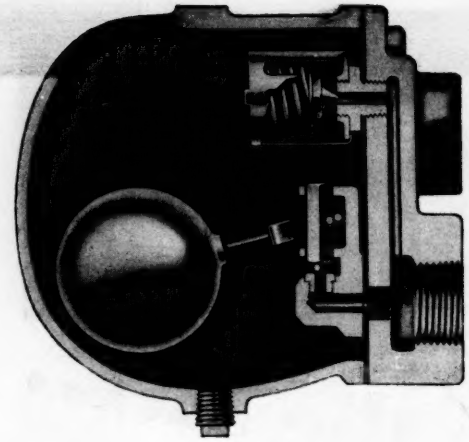
For very good reasons the boiler-room was placed at roof level. (Boiler-room is directly behind roof sign at top of building, instead of conventional location in basement.) First, since it was a bank building, basement space was extremely valuable for vaults, storage, and air conditioning equipment. Then, too, with the fresh air intake on the top of the building, a considerable amount of piping was eliminated by placing the boilers at the same point. Since Cleaver-Brooks boilers require only a simple vent for carrying off combustion gases, long stack runs were eliminated, leaving additional valuable space within the building.

These are just a few of the many reasons why Cleaver-Brooks boilers were specified. Being completely self-contained and compact in design, requiring minimum head room and floor area, Cleaver-Brooks boilers presented no installation problem.

Cleaver-Brooks Self-Contained Boilers are available for oil, gas, combination oil and gas firing, 15 to 500 hp, 15 to 250 p.s.i., for heating and processing loads. Write for the catalog.

CLEAVER-BROOKS COMPANY
366 E. Keefe Avenue • Milwaukee 12, Wis.

Cleaver-Brooks
STEAM BOILERS
The First and Finest of their Class



COMMON SENSE approach to

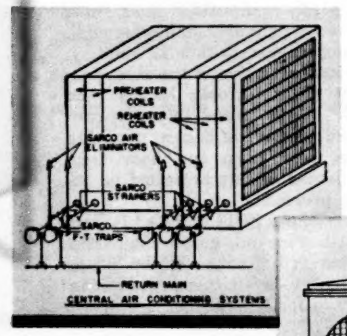
TRAP SELECTION FOR UNIT HEATERS

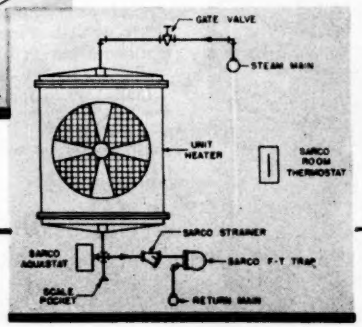
what are the requirements for efficient unit heater or blast heater drainage?

1. High starting load capacity to deal with cold air and low steam pressure resulting from peak load.
2. Free discharge of incondensables on starting and during running.
3. Continuous condensate discharge to prevent hot and cold air blasts.
4. Release of condensate at or near steam temperature.

why is the Sarco type F.T. the ideal steam trap for such heaters?

1. The float operated main valve can be sized to handle the condensate loads from the lowest pressures up to maximum design pressure.
2. The built-in air vent prevents air binding under starting or running conditions.
3. Sarco F.T. traps discharge condensate continuously, as soon as it forms—don't need to cool or to wait until steam leaks out of buckets before they fill and discharge.
4. The float level and, therefore, the valve opening is controlled by the rate of condensate flow into the trap. On no load, the valve is closed.



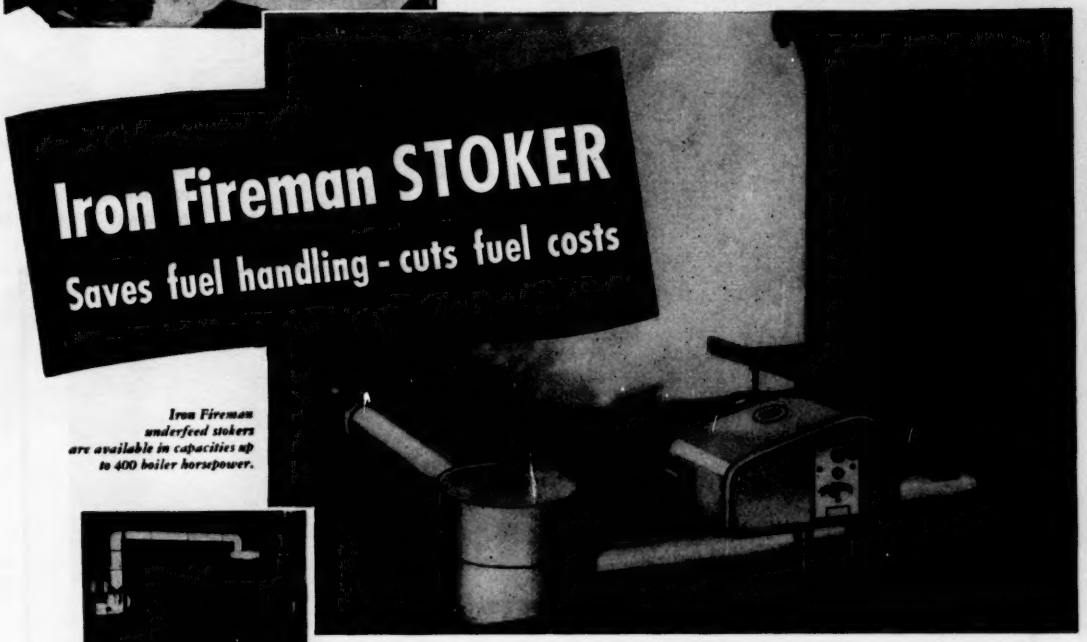


New Bulletin 455 contains full information on latest improvements.

SARCO COMPANY, INC.
EMPIRE STATE BUILDING, NEW YORK 1, N. Y.
Represented in Principal Cities
SARCO CANADA LTD., TORONTO 5, ONTARIO

335

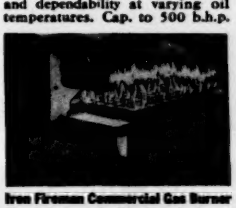
Can you afford to waste what Iron Fireman users are saving?



Iron Fireman underfeed stokers are available in capacities up to 400 boiler horsepower.

Iron Fireman Pneumatic Spreader
Dries, pre-heats, conveys coal pneumatically. Burns low cost coals efficiently. Up to 1000 boiler h.p. with multiple units for larger boilers.

Iron Fireman Rotary Oil Burner
Fires low-cost, heat-rich heavy oils (5 & 6) with complete steadiness and dependability at varying oil temperatures. Cap. to 500 b.h.p.



Iron Fireman Commercial Gas Burner
Verticle type is illustrated above. Others include Radiant Inshot and Ring types. Flexible operation, easy to install. Capacities to 400 b.h.p.

Here's a complete COAL HANDLING and COMBUSTION SYSTEM— all in one package

To coal's basic advantages (low cost and availability) Iron Fireman stokers add many new ones:

1. Coal is fed direct from the coal bunker or bin without manual handling.

2. Iron Fireman precision controls are extremely accurate and dependable. They are capable of automatically adjusting the stoker firing rate to the boiler load, even when steam demands fluctuate from a "stand-by" status to the maximum capacity of the boiler.

3. Air and fuel are so perfectly proportioned that the clean, brilliant fuel bed produces a maximum amount of heat per fuel dollar.

For further information mail the coupon below, or call your local Iron Fireman dealer for complete survey of your boiler plant. There is no costor obligation to you.

IRON FIREMAN MANUFACTURING COMPANY
3161 West 106th Street, Cleveland 11, Ohio.
Please send literature as checked:
☐ Coal-Flow Stoker ☐ Rotary Oil Burner
☐ Pneumatic Spreader Stoker ☐ Commercial Gas Burner

Let Iron Fireman engineers help decide which fuel is best for *your* plant.

*Name*_____

*Address*_____

IRON FIREMAN

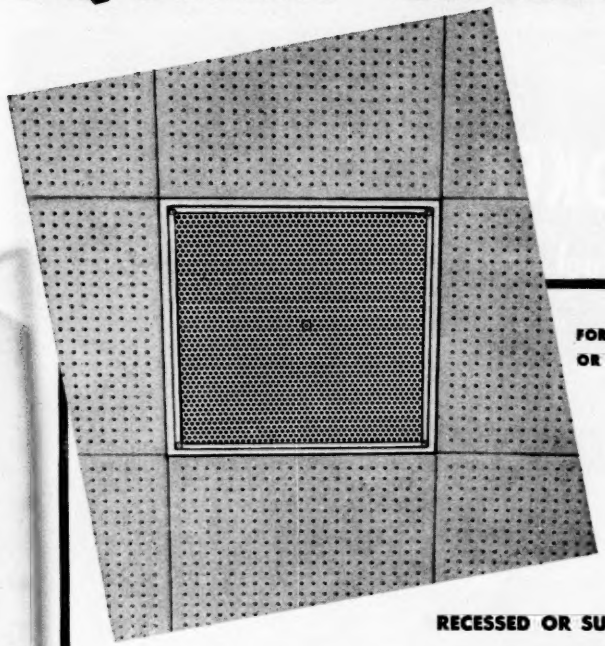
AUTOMATIC FIRING EQUIPMENT FOR OIL, GAS, COAL

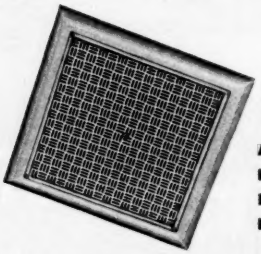
BARBER COLMAN

uni-flo®

INCONSPICUOUS! FLEXIBLE!

THE ONLY ADJUSTABLE SQUARE CEILING OUTLET

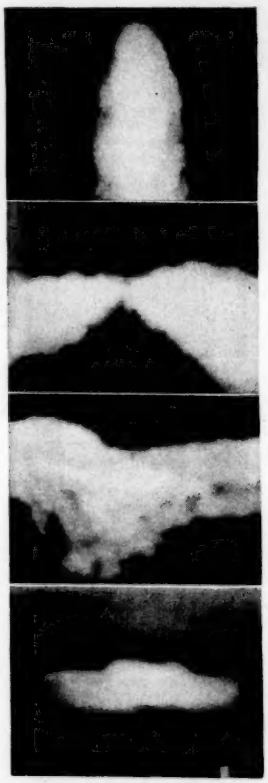




AVAILABLE IN SEVERAL PERFORATION PATTERNS

FOR ACOUSTICAL TILE OR PLASTER CEILING

RECESSED OR SURFACE TYPES



ADJUSTS TO ANY DISTRIBUTION REQUIREMENT

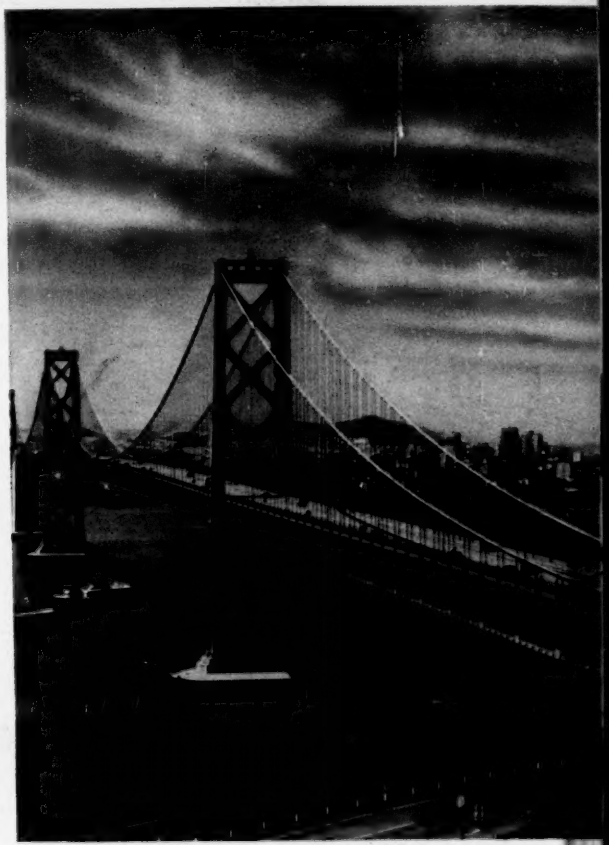
UNI-FLO Square Ceiling Outlets are adjustable *on the job and after installation* to discharge air in one, two, three, or four directions and provide air patterns from vertical to horizontal as illustrated. Adjustments are easily made internally and *do not alter the outward appearance of the unit.* For ease in system balancing, opposed-blade, gang-operated volume controls are available. Actual tests in the laboratory and on the job prove the superior performance of the UNI-FLO Square Ceiling Outlet.

Write for Bulletin F-4728

BARBER COLMAN

BARBER-COLMAN COMPANY, 1224 Rock Street, Rockford, Illinois

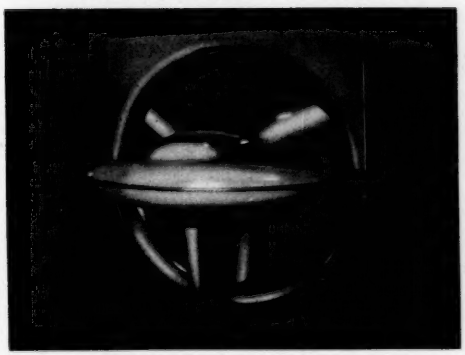
American Blower—a time-honored name in air handling



If you look before you buy, we're certain you'll buy American Blower Air Handling Equipment. There's a vast difference in quality, design, quietness, operating costs and efficiency. Buyers' tests prove the superiority of American Blower products.

In the San Francisco area, for air handling data call American Blower—Sutter 1-1024. In other areas consult your phone book. NOTE: To better serve our western customers American Blower has built another new plant—conveniently located in San Leandro, California.

Product of the month



American Blower Model A Ventura Ventilating Fan. 12 Sizes. Capacities from 1000 cfm to 9700 cfm, free delivery.

Good ventilation is good business!

Considering ways to step up sales? Thinking of improving working conditions in your plants and offices?

An excellent way to accomplish these aims is to improve the ventilation in your business. That's why we suggest you investigate the advantages of American Blower Ventura Fans this month.

American Blower Ventura Fans are attractively streamlined propeller fans with smooth flowing lines that harmonize well with modern business interiors. A square mounting panel makes the Ventura Fan easy to install, and wiring is fully enclosed for safety.

All Ventura Fans are sound rated and carry Certified Ratings in accordance with the Standard Test Code as adopted jointly by the N.A.F.M. and the A.S.H. & V.E.

You can get full details from your contractor or the nearest American Blower Branch Office. Ask for a free ventilation survey now!

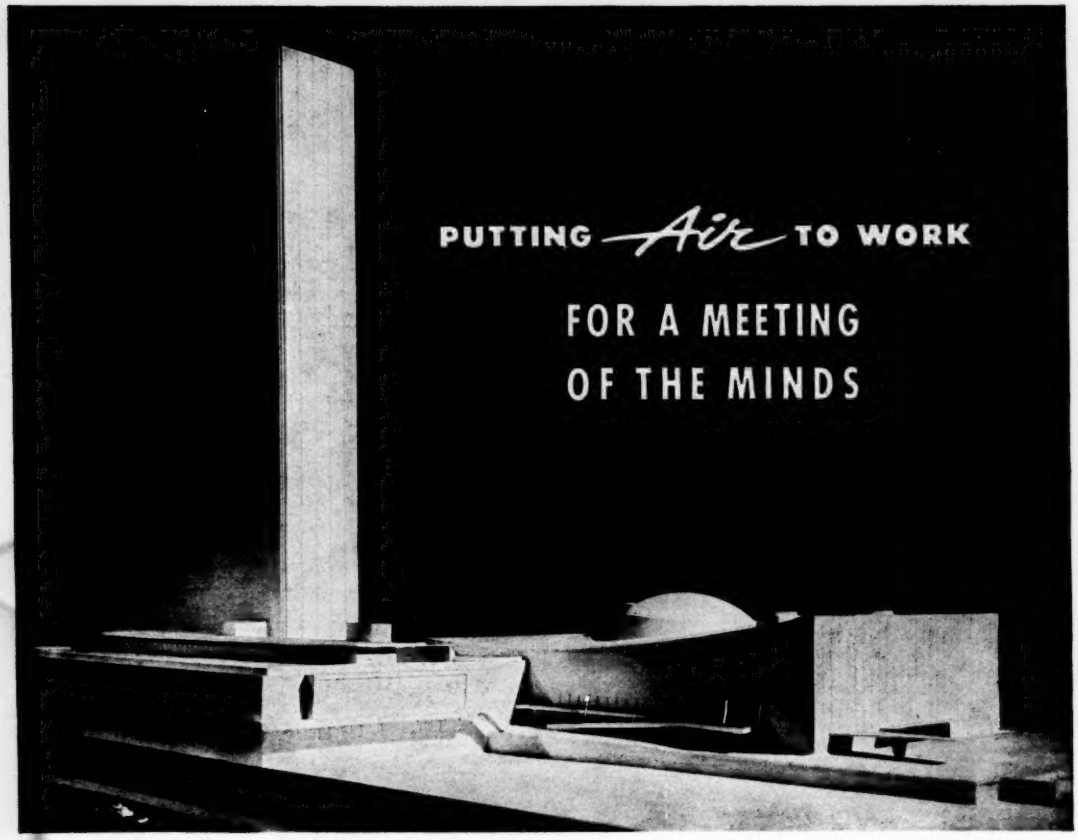
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

YOUR BEST BUY AMERICAN BLOWER AIR HANDLING EQUIPMENT

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON



Harrison & Abramovitz, New York, Architects • Syska & Hennessy, Inc., New York, Consulting Engineers • Fuller-Turner-Walsh-Slattery, Inc., New York, General Contractors • Kerby Saunders, Inc., New York, Mechanical Contractor, Council Chambers

The United Nations is burning the midnight oil. Because its decisions affect millions of people, it is essential that its policy-making delegates and officials meet in an atmosphere conducive to careful deliberation, free from distraction and discomfort.

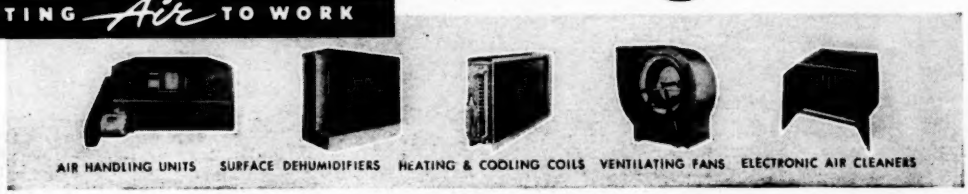
In the Council Chambers, for example, a constant flow of conditioned air provides this important atmosphere. Dependable Westinghouse-Sturtevant Air Handling apparatus contributes to the comfort and continuity of operation for which the air conditioning was designed by Syska & Hennessy, Inc., the Consulting Engineers.

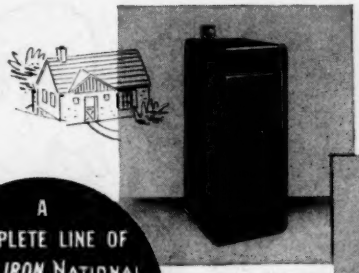
There's a complete line of Westinghouse equipment to help you *put air to work* . . . with air conditioning, air moving, or air cleaning. Contact your local Sturtevant office, or write Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Massachusetts.

YOU CAN BE SURE...IF IT'S **Westinghouse**

PUTTING Air TO WORK

J-80217



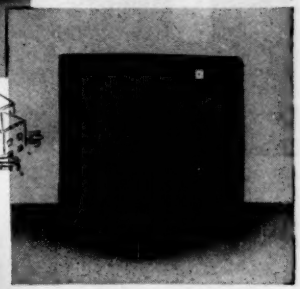


"100" series—smart and compact for small home installations in kitchens, basements or utility rooms. Wet base construction.

"200" series—sturdy, dependable heating plant for medium to larger size homes or commercial buildings with equivalent heating needs.

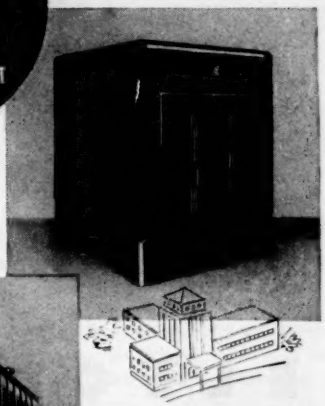
"300" series—superbly efficient plant for homes, apartments and commercial buildings where heating needs are beyond those of average size.

A COMPLETE LINE OF *CAST IRON* NATIONAL *HEAT EXTRACTORS* FOR COAL—OIL—GAS



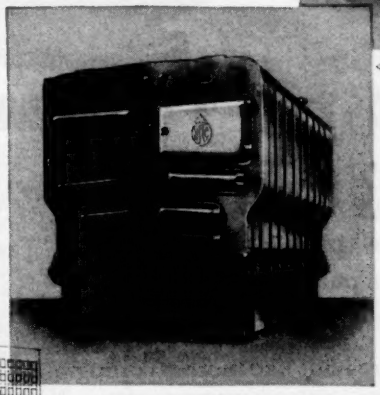
This well-known NATIONAL family of profit-producers is available for 1951 business

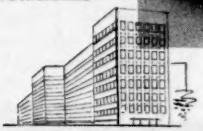
EASILY CONVERTED TO AUTOMATIC FIRING IF INSTALLED AS A HAND FIRED UNIT



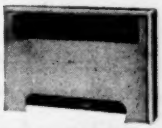
Whatever the size of the job or the requirements, there is a Cast Iron National Heat Extractor (steam or hot water) ready to fill the bill with utmost satisfaction. Over nine years of engineering research and development have provided these valued features—economical performance, long efficient life, compactness, smart appappearance, easy convertibility to any fuel—which make National Heat Extractors so readily saleable and so highly acceptable to customers. Sizes range in Net I-B-R Ratings from 170 to 10,300 sq. ft. of steam and from 270 to 16,480 sq. ft. of water for hand or automatic firing. For year 'round domestic hot water, National Heat Extractors can be equipped with a tankless or storage type heater. Write for literature on National Heat Extractors, National Aero Convectors, National Art Radiators or other products of the *Complete* line of National Heating products.

"400" series—for large buildings and institutions. Big in performance, small in streamlined proportion—provides economy and efficiency in big boiler operation.





"500" series—high capacity for the largest heating jobs—schools, hospitals, apartments and hotels. "Twin Sections" for easy installation without major structural alterations.



NATIONAL AERO CONVECTORS

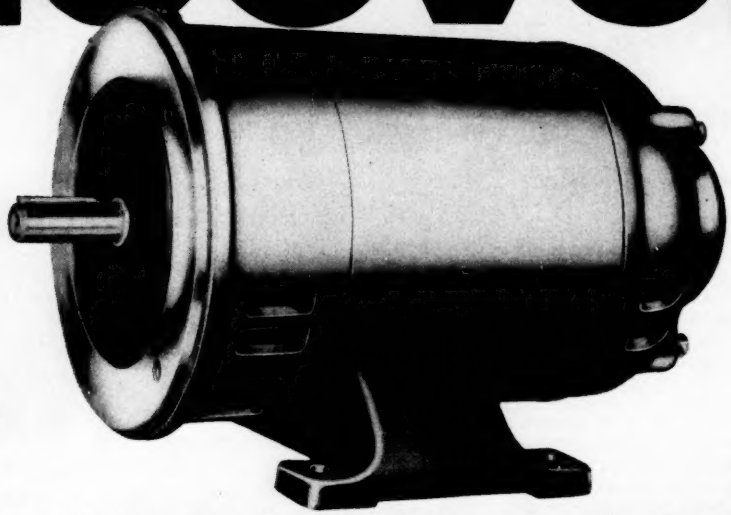
Constructed of enduring cast iron, they tuck away beneath windows or in convenient recesses and blanket room with a perfect balance of convected and radiant heat. Cast Iron National Art Radiators for free standing or semi-recessed installation are also famous for effective heat distribution.

THE NATIONAL RADIATOR COMPANY

JOHNSTOWN, PENNSYLVANIA

A sweet sale to rest your reputation on...

Hoover®



ELECTRIC MOTORS

Your reputation largely depends on keeping your customers happy with what you sell them. So whenever you sell or install a motor for a ventilator, furnace or pump—for a home workshop or any other use—make it a Hoover Motor!

Hoover Motors are built like motors costing far more. They give your customers long, quiet, dependable service. And whatever your customers' needs, there's almost sure to be a Hoover Motor to suit them—to rest *your* reputation on!

Here's a new general-purpose Hoover Motor that's typical of the wide Hoover line. It's a NEMA "C" face-integral HP motor. It's designed for such applications as circulating water pumps, sewage pumps, machine tools where vertical operation is required, and any other general-purpose application suitable to face-mounted motors. It is drip-proof and has a totally enclosed, dust-proof, external switch housing. It also comes in a vertical model with a canopy.

Other capacitor-start, general-purpose motors from ¼ through 3 HP. Polyphase motors from ¼ through 5 HP. Besides these general-purpose motors, there are many Hoover Motors designed especially for pumps, oil burners, fans and blowers. Write for details.

THE HOOVER COMPANY
Kingston-Conley Division
68 Brook Avenue
North Plainfield, New Jersey

how to move air without FAN-FARE

use

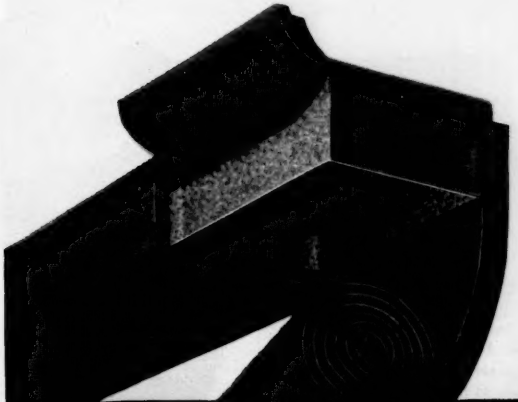
ULTRALITE

DUCT INSULATION and DUCT LINER

ULTRALITE Duct Liner reduces fan chatter to a w-h-i-s-p-e-r—and it's so easy to install! The long glass fiber captures and absorbs fan noise, lets heating and air conditioning systems run at peak efficiency without disturbing anyone.

And ULTRALITE Duct Liner is easier and more economical to install than any liner you've ever used! You can cut it with a knife . . . run it quickly around curves and corners . . . fasten it securely in place with cement or screws and washers.

For the same good reasons, you'll want to use ULTRALITE Duct Insulation. It goes on faster, cheaper, and does a better job of keeping heat and cold where they belong. You have a choice of *6 attractive vapor barrier facings,* one of which is tailor-made for your particular condensation problem.



ULTRALITE comes in easy-to-handle rolls, in various widths and densities. The long glass fibers are fire-resistant, non-corrosive, non-irritating and as permanent as glass itself. It will not settle, shake loose, delaminate or disintegrate under air movement or vibration.

For free samples and catalog A.I.A. File No. 37-D-2, WRITE TODAY!

Please send me samples of ULTRALITE and catalog A.I.A. File No. 37-D-2. HV-5

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

GUSTIN-BACON MFG. CO.

7412 W. 12TH ST., KANSAS CITY, MO.

NEW YORK CHICAGO PHILADELPHIA

LOS ANGELES HOUSTON TULSA

This Specialty Shop COMBINED Air Conditioning AND Winter Heating AND SAVED 38% by using a DRAVO COUNTERFLO HEATER

It's accepted as a merchandising "must" that better stores today have to provide summer air conditioning for customers as well as winter warmth . . . and the new Bramson Specialty Shop in Evanston, Ill., found a way to do it without the usual high cost and complication.

By using a Dravo Counterflo for winter heating, one set of duct-work serves the year-round, eliminating the cost and complication of a parallel piping system. All equipment is concentrated in a small utility area, readily accessible for adjustment or attention. The complete installation cost $14,000 less than the lowest bid on a wet-type heating system plus equivalent conditioning apparatus . . . a saving of 38%.

During the winter, heated fresh and recirculated air are automatically blended, balancing heat input to heat loss and maintaining selected temperatures in various locations with minimum fuel. In summer, air volume is increased by adjusting vari-pitch sheaves on the blower motor. Because of the stainless steel combustion chamber of the heater, conditioned air can be circulated through the unit without danger of corrosion. The ever-present problem of excess infiltration of air at entrance doors is solved by the use of ducts which discharge heated or cooled air into the entrance area. Aside from turning switches for winter or summer operation, control is completely automatic.

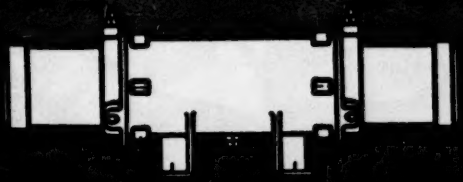
DRAVO
CORPORATION
DRAVO BUILDING, PITTSBURGH 22, PA.

If you have a heating-air conditioning problem, you, too, may find the Dravo Heater an ideal means of reducing installation, operation, and maintenance costs. Ask for a case history describing the Bramson installation in detail . . . and, for full data on the Dravo Counterflo Heater, ask for Bulletin IJ-523-910

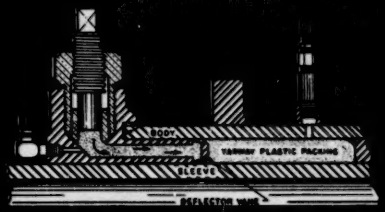
DRAVO

Dravo also manufactures the *DRAVO CRANE CAB COOLER* for air conditioning hot-metal crane cabs.
PITTSBURGH • CLEVELAND • PHILADELPHIA • DETROIT • NEW YORK • CHICAGO • ATLANTA • BOSTON
Sales Representatives in Principal Cities. Mfd. and Sold in Canada by Marine Industries, Ltd., Sorel, Quebec
Export Associates: Lynch, Wilde & Co., Washington 9, D. C.

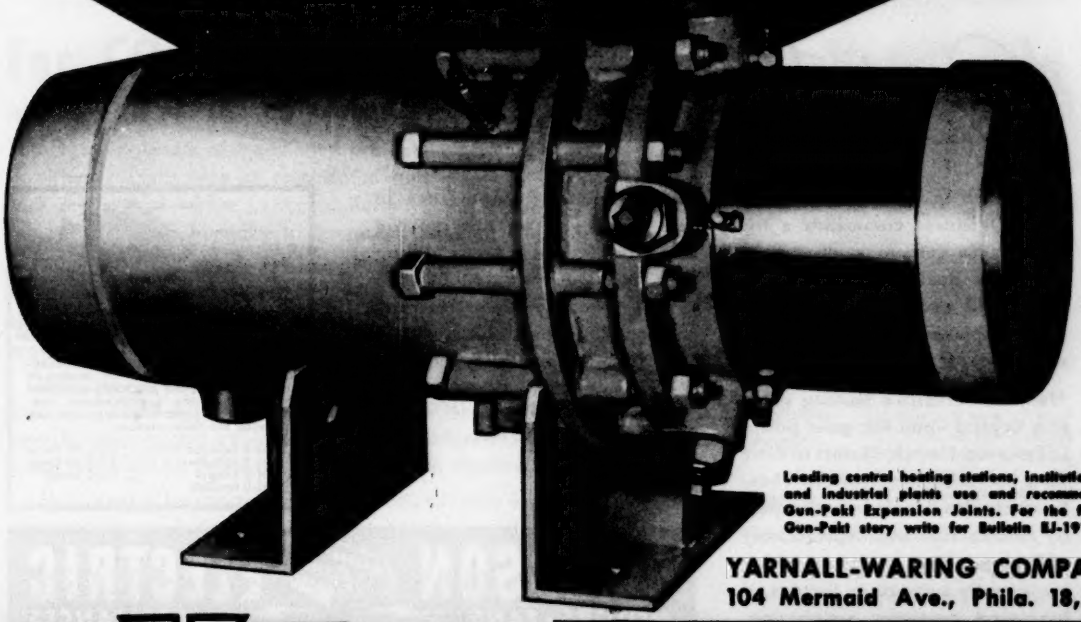
YOU NEED FEWER JOINTS



AND LESS MAINTENANCE



W... GUN-PAKT ...ints



Leading central heating stations, institutions and industrial plants use and recommend Gun-Pakt Expansion Joints. For the full Gun-Pakt story write for Bulletin EJ-1912.

YARNALL-WARING COMPANY
104 Mermaid Ave., Phila. 18, Pa.

YARWAY GUN-PAKT EXPANSION JOINT

"Quiet" POWER

NOISE is on the black list. Quietness commands a top position in surveys made to rate the most desirable features of motorized products. How does *your equipment* meet this present-day standard?

Many of America's leading products depend upon the quiet power of Emerson-Electric Motors to drive their operating mechanisms. These products also benefit from the quality construction and dependability of Emerson-Electric Motors, which are equally important factors in long-term customer satisfaction.

The accumulated experience in designing and manufacturing Emerson-Electric Motors, dating from the pioneering days of 1890 to the present, is yours to command without obligation. Ratings 1/20 to 5 h.p. Your inquiry is invited.

THE EMERSON ELECTRIC MFG. CO.
St. Louis 21, Mo.

Write for these Emerson-Electric Motor Data Bulletins

Appliance and equipment manufacturers, with applications for motors of 1/20 to 5 h.p., can profitably use these reference guides. Specifications, construction and performance data are included for these motors:

- ☐ 131-A Capacitor-Start
- ☐ 131-B Split-Phase
- ☐ 131-C Integral
- ☐ 131-D Fan-Duty
- ☐ 131-E Oil-Burner
- ☐ 131-F Jet Pump
- ☐ 131-G Blower

EMERSON Emerson Electric **ELECTRIC**
MOTORS • FANS APPLIANCES

MULTI-VENT

Low Velocity Air Diffusion CEILING PANELS

Architects — Narramore, Bain, Brady & Johnson.

Engineers — Lincoln Boullion & Associates

Multi-Vent Panels are installed throughout the Bank building, completely concealed in standard acoustical ceilings. Air is introduced and exhausted through the perforations in standard metal ceiling pans, eliminating all visible outlets or grilles.

For *COMPLAINT-FREE* Heating and Ventilating

IN THE SAN FRANCISCO FEDERAL RESERVE BANK, SEATTLE BRANCH

Top-flight engineers and architects are now specifying Multi-Vent for air distribution in virtually every type of commercial and industrial building, new or old, *where true comfort*, or where perfect uniformity and accurate control of air movement, temperature, and humidity is demanded by their clients.

For unlike any other diffuser on the market today, Multi-Vent panels do *not* depend on BLOW or THROW, (high velocity injection) for distribution. In fact Multi-Vent provides perfect over-all air distribution entirely by pressure displacement, completely free from BLOW.

This pressure displacement principle, exclusive with Multi-Vent, does away with the main sources of draft hazards . . . thereby eliminating all of the most serious installation, balancing, and adjustment problems, inherent in the velocity injection principle, upon which all air diffusers *except* Multi-Vent depend.

Multi-Vent is by far and away the best, not only in performance, but in efficiency, appearance, and economy of maintenance as well.

See Sweet's Arch. & Eng. Files or write for detailed literature and the name of the Multi-Vent sales engineer in your vicinity.

THE PYLE-NATIONAL COMPANY
1374 NORTH KOSTNER AVENUE, CHICAGO 51, ILL.

MULTI-VENT DIVISION

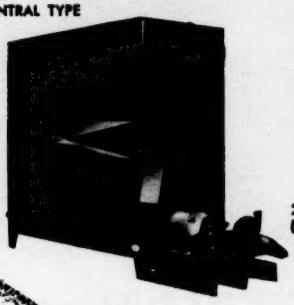
Now More Than Ever

It's *Curtis* for PROFITS

Because Most Installations are Within the Curtis Range — 2 through 40 Tons

10 and 15 Ton
Complete CENTRAL TYPE

2 through 8 Ton PACKAGED UNITS
(Shipped to you completely assembled)



Evaporative Condensers, Cooling Towers and Air Handling Units

With these units, you can handle any AIR CONDITIONING — REFRIGERATION or AIR MOVING JOB within this range — and when the job is sold, it STAYS *SOLD* because the QUALITY IS THERE. No corners have been cut in the manufacture of Curtis equipment — pound for pound, it's the best buy in the industry.

¼ H.P. through 40 H.P.
Condensing Units.

Advertising Support A-Plenty

SATURDAY EVENING POST

TIME

NEWSWEEK

and many special consumer publications are pre-selling Curtis equipment to your prospects.

NOTE — A Curtis franchise may be open in your area. Write, giving full details.

97 Years of Successful Manufacturing

CURTIS REFRIGERATING MACHINE DIVISION
of Curtis Manufacturing Company

1999 Kienlen Ave., • St. Louis 20, Mo.

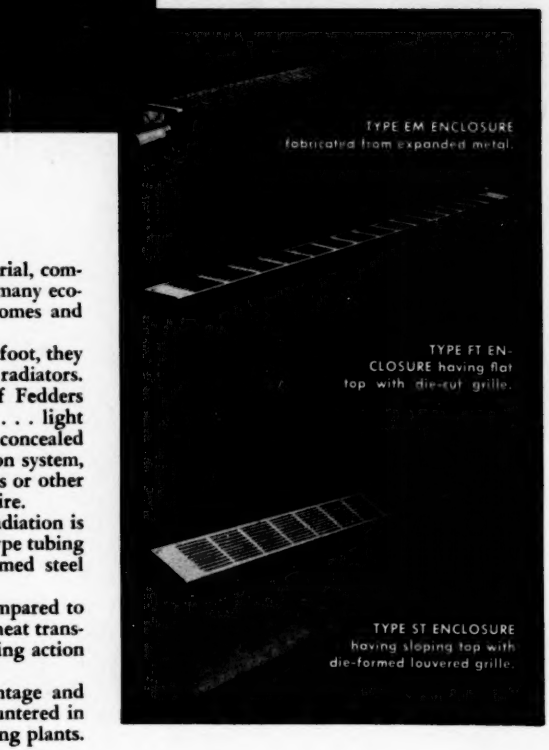
Curtis

R-51-1

fedders

WALL RADIATION

fedders



APPLICATIONS

Fedders Wall Radiation is well adapted for industrial, commercial, and institutional buildings. They also have many economical residential applications in heating entire homes and apartments.

Due to their high heat transfer efficiency per lineal foot, they occupy far less space than pipe coils or bulky cast iron radiators.

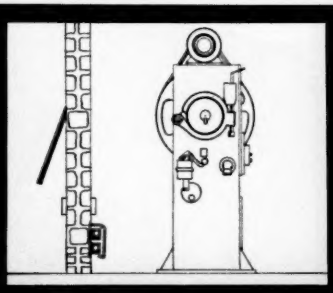
High heat transfer and aerodynamic efficiency of Fedders Wall Radiation results in space-saving installations . . . light weight for easy handling . . . low cost for exposed or concealed radiation. They can be used as the complete radiation system, or installed in conjunction with Fedders Unit Heaters or other equipment, as layout or heating load conditions require.

The high heat transfer output of Fedders Wall Radiation is based on use of cold drawn, seamless steel, pressure type tubing bullet expanded into self-spacing, collared, die-formed steel fins.

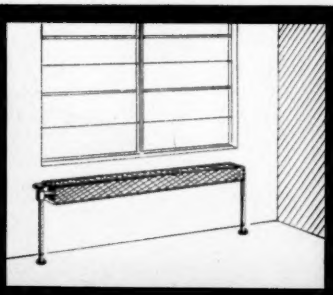
Collared fins provide larger fin-to-tube contact compared to usual line contact fins. This increases the amount of heat transfer. Die-formed pattern adds turbulence and scrubbing action to air flow, plus added fin strength.

They are easily cleaned, — a heat transfer advantage and maintenance economy in dust-laden conditions encountered in textile mills, foundries, flour, feed and food processing plants.

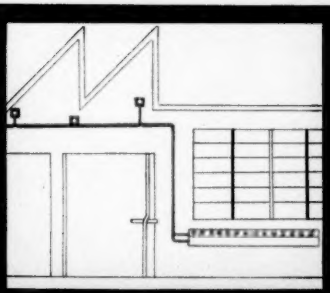
Showing how Fedders Wall Radiation can be spotted to kill cold spots adjacent to working areas.



Drafts from windows and exposed walls are eliminated by locating Fedders Wall Radiation under windows or along walls.



More uniform temperatures can be maintained by locating Fedders Wall Radiation at points where drafts begin.



FEDDERS-QUIGAN CORPORATION, BUFFALO 7, N. Y.

fedders

WALL RADIATION

HOT WATER

CAPACITY PER FOOT OF LENGTH

60 F ENTERING AIR

AVERAGE WATER TEMPERATURE 190 F

	Rows High	LESS ENCLOSURE Btu/hr	ENCLOSURE		
			TYPE EM Btu/hr	TYPE FT Btu/hr	TYPE ST Btu/hr
1¼" Pipe 50 Fins Per Ft	1	915	880	890	900
	2	1650	1580	1810	1895
	3	2190	2100	2640	2730
	4	2930			
1¼" Pipe 38 Fins Per Ft	1	750	725	730	740
	2	1350	1310	1490	1560
	3	1800	1730	2160	2250
	4	2400			
2" Pipe 24 Fins Per Ft	1	900	870	880	890
	2	1620	1560	1800	1870
	3	2150	2070	2580	2670
	4	2880			

AVERAGE WATER TEMPERATURE 200 F

	Rows High	LESS ENCLOSURE Btu/hr	ENCLOSURE		
			TYPE EM Btu/hr	TYPE FT Btu/hr	TYPE ST Btu/hr
1¼" Pipe 50 Fins Per Ft	1	1010	965	980	990
	2	1810	1740	2000	2080
	3	2410	2310	2900	3000
	4	3220			
1¼" Pipe 38 Fins Per Ft	1	825	800	810	815
	2	1490	1440	1640	1720
	3	1980	1900	2380	2480
	4	2640			
2" Pipe 24 Fins Per Ft	1	990	955	960	975
	2	1790	1720	1960	2060
	3	2360	2280	2850	2950
	4	3170			

AVERAGE WATER TEMPERATURE 215 F

	Rows High	LESS ENCLOSURE Btu/hr	ENCLOSURE		
			TYPE EM Btu/hr	TYPE FT Btu/hr	TYPE ST Btu/hr
1¼" Pipe 50 Fins Per Ft	1	1150	1100	1120	1135
	2	2070	1990	2280	2380
	3	2750	2640	3310	3430
	4	3680			
1¼" Pipe 38 Fins Per Ft	1	945	910	920	930
	2	1700	1640	1870	1960
	3	2265	2170	2730	2830
	4	3020			
2" Pipe 24 Fins Per Ft	1	1130	1090	1100	1120
	2	2040	1960	2240	2350
	3	2700	2600	3250	3370
	4	3620			

fedders

WALL RADIATION

HOT WATER

CAPACITY PER FOOT OF LENGTH

60 F ENTERING AIR

AVERAGE WATER TEMPERATURE 160 F

	Rows High	LESS ENCLOSURE Btu/hr	ENCLOSURE		
			TYPE EM Btu/hr	TYPE FT Btu/hr	TYPE ST Btu/hr
1¼" Pipe 50 Fins Per Ft	1	650	625	630	640
	2	1170	1130	1290	1345
	3	1555	1495	1870	1940
	4	2080			
1¼" Pipe 38 Fins Per Ft	1	535	515	520	525
	2	960	930	1055	1110
	3	1280	1230	1540	1600
	4	1705			
2" Pipe 24 Fins Per Ft	1	640	615	625	635
	2	1155	1110	1280	1330
	3	1525	1470	1840	1905
	4	2045			

AVERAGE WATER TEMPERATURE 170 F

	Rows High	LESS ENCLOSURE Btu/hr	ENCLOSURE		
			TYPE EM Btu/hr	TYPE FT Btu/hr	TYPE ST Btu/hr
1¼" Pipe 50 Fins Per Ft	1	735	705	710	725
	2	1320	1270	1460	1520
	3	1760	1690	2120	2200
	4	2360			
1¼" Pipe 38 Fins Per Ft	1	605	580	590	600
	2	1090	1050	1195	1255
	3	1450	1380	1740	1810
	4	1940			
2" Pipe 24 Fins Per Ft	1	724	695	705	715
	2	1305	1250	1445	1500
	3	1720	1660	2080	2170
	4	2315			

AVERAGE WATER TEMPERATURE 180 F

	Rows High	LESS ENCLOSURE Btu/hr	ENCLOSURE		
			TYPE EM Btu/hr	TYPE FT Btu/hr	TYPE ST Btu/hr
1¼" Pipe 50 Fins Per Ft	1	825	815	820	825
	2	1480	1420	1630	1700
	3	1970	1880	2370	2460
	4	2630			
1¼" Pipe 38 Fins Per Ft	1	675	650	660	665
	2	1215	1180	1350	1400
	3	1620	1550	1950	2030
	4	2160			
2" Pipe 24 Fins Per Ft	1	810	780	790	800
	2	1460	1405	1625	1675
	3	1935	1860	2330	2420
	4	2600			

fedders

CONVENIENCE

Fedders design provides a highly efficient heat transfer surface that is easy to stock, easy to handle, easy to deliver and easy to install on the job. Weights are measured in pounds instead of tons.

HOOK-UPS

Lengths from 2′ to 12′ in 6″ increments are available with 1¼″ and 2″ nominal pipe sizes. 38 and 50 fins per foot available on 1¼″ pipe, and 24 fins per foot available on 2″ pipe.

Choice of threaded ends for standard pipe connections or plain ends bevelled for welding on the job.

QUICK RESPONSE

Fedders Wall Radiation provides quick response to manual or thermostatic control. This contributes to uniform temperatures. Fuel economy is further increased by fast warm-up after weekend shutdowns, and when sudden outdoor weather changes occur.

COVERS

Expanded steel mesh, or solid front having flat or sloping top with die cut grille. Butt and corner joining strips available as specified. Solid front covers act as convectors giving a stack effect which increases capacity.

Covers are finished with one-coat of primer. Heating element is finished in one coat of neutral paint.

STEAM CAPACITY PER FOOT OF LENGTH

60 F ENTERING AIR 1 PSI STEAM

	Rows High	LESS ENCLOSURE		ENCLOSURE					
				TYPE EM		TYPE FT		TYPE ST	
		Btu/hr	EDR	Btu/hr	EDR	Btu/hr	EDR	Btu/hr	EDR
1¼″ Pipe 50 Fins Per Ft	1	1410	5.87	1350	5.63	1370	5.70	1390	5.80
	2	2540	10.60	2440	10.16	2800	11.67	2920	12.18
	3	3380	14.10	3240	13.50	4060	16.90	4220	17.55
	4	4520	18.85						
1¼″ Pipe 38 Fins Per Ft	1	1160	4.84	1115	4.65	1130	4.70	1140	4.75
	2	2085	8.70	2015	8.42	2295	9.56	2400	10.00
	3	2780	11.60	2670	11.12	3340	13.90	3470	14.45
	4	3710	15.45						
2″ Pipe 24 Fins Per Ft	1	1390	5.80	1335	5.55	1350	5.62	1360	5.67
	2	2500	10.40	2400	10.00	2750	11.45	2880	12.00
	3	3320	13.82	3190	13.30	3990	16.60	4140	17.25
	4	4440	18.50						

NOTE:—240 Btu = 1 EDR.

It is good installation practice to limit length of runs to 100 ft. on 1 lb. differential pressure, and 150 ft. for 2 lb. or greater supply pressure. Longer runs should be hooked up to a separate supply and trap.

HOW TO ORDER--

1. Specify pipe size and fin spacing desired.
2. State desired length of heating element in accordance with roughing in dimensions on page 6. Radiation longer than 12 ft. furnished from various stock lengths for convenient shipping and assembly on the job.
3. Specify choice of threaded or bevelled ends.
4. Advise number of hanger brackets required.

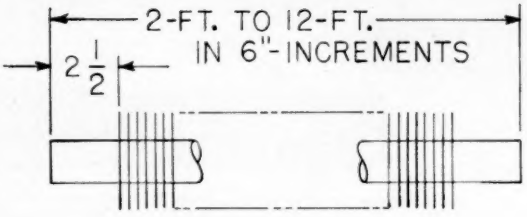
When enclosure is desired, specify type, length and height.

TYPE EM Enclosure made of expanded metal.

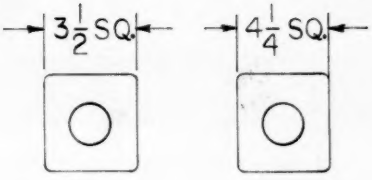
TYPE FT Enclosure has solid front and flat top.

TYPE ST Enclosure has sloping top with die-formed grille.

SPECIFICATIONS AND DIMENSIONS

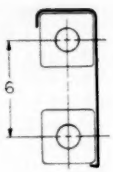


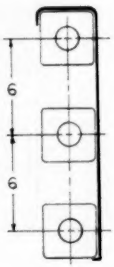
1 1/4" & 2" PIPE
WITH THREADED OR CHAMFERED ENDS

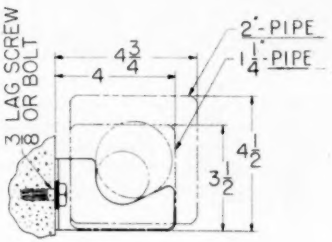


1 1/4" PIPE
38 & 50
FINS / FT.

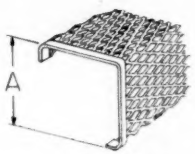
2" PIPE
24-FINS
PER FOOT





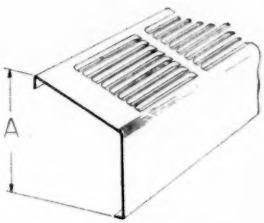


COVERS



EXPANDED METAL (E.M.)
LENGTHS: 2-FT. TO 7-FT. IN 6"-INCREMENTS.

FLAT TOP (F.T.)
LENGTHS: 2'-2" TO 7'-2" IN 6"-INCREMENTS



SLOPING TOP (S.T.)
LENGTHS: 2-FT. TO 7-FT. IN 4"-INCREMENTS.

DISTANCE FROM WALL TO FACE OF COVER

COVER TYPE	1-HIGH			2-HIGH			3-HIGH		
	EM	FT	ST	EM	FT	ST	EM	FT	ST
1¼" Pipe	4 3/16	4 1/8	4 1/8	4 3/16	4 1/8	4 1/8	4 3/16	4 1/8	4 1/8
2" Pipe	5	4 1/8	4 1/8	5	4 1/8	4 1/8	5	4 1/8	4 1/8

"A" DIMENSION

COVER TYPE	1-HIGH			2-HIGH			3-HIGH		
	EM	FT	ST	EM	FT	ST	EM	FT	ST
1¼" Pipe	3 7/8	3 3/4	6 1/2	9 7/8	9 3/4	12 1/2	15 7/8	15 3/4	18 1/2
2" Pipe	4 5/8	4 1/2	7 5/8	10 5/8	10 1/2	13 5/8	16 5/8	16 1/2	19 5/8

The Fedders-Quigan policy is one of continuous improvement, and therefore the right is reserved to make changes without notice

It's time we got *working* mad!

As we listen to the latest insults from Moscow, we're likely to get fighting mad.

Instead, we'd better use our heads and get *working* mad.

It is clear by now that Stalin and his gang respect just one thing—strength. Behind the Iron Curtain they've been building a huge fighting machine while we were reducing ours. Now we must rebuild our defenses—*fast.*

As things stand today, there is just *one* way to prevent World War III. That is to re-arm—to become strong—and to stay that way!

This calls for better productivity all along the line. Not just in making guns, tanks and planes, but in turning out civilian goods, too.

Arms must come first. But we must produce arms *at the same time* we produce civilian goods.

We can do this double job if we all work together to turn out more for every hour we work—if we use our ingenuity to step up productivity.

All of us must now make sacrifices for the common good. But we're working for the biggest reward of all —*peace with freedom!*

THE BETTER WE PRODUCE THE STRONGER WE GROW

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make it yours
with dependable quality

CRANE VALVES

No. 960 Crane Brass Pressure Regulator for steam or air. Literature on request through your Crane Branch or Crane Wholesaler.

A CASE HISTORY FROM CRANE FILES

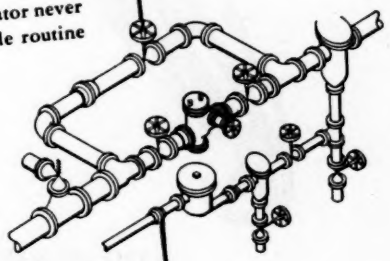
PROBLEM: To choose a pressure regulator that would assure a steady, unvarying steam supply to cooking kettle for an exacting brewing process.

WORKING CONDITIONS: Regulator subject to continuous operation 24 hours per day. Main steam supply at 100 psi to be constantly reduced and maintained at 30 psi.

SOLUTION: Crane No. 960 Brass Pressure Regulator. (*Former model with integral non-renewable cylinder.*)

RESULT: For 16 years, throughout its lifetime, the Crane 960 Regulator never failed, never faltered, never required more than prescribed simple routine servicing.

Replaced with new Model 960 Crane Pressure Regulator. With all wearing parts renewable, it will virtually never wear out. Now in service 18 months; operating cost: zero.



A typical example of the long life and low-cost maintenance that make Crane Quality the best value in all types of valves. That's why... More CRANE VALVES are used than any other make

CRANE

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VALVES • FITTINGS • PIPE • PLUMBING • HEATING

Depend on FAR-AIR for better air filtration . . .

Specify FAR-AIR Filters like this:

"Filters shall be permanent, impingement, washable, all metal, panel type. Media shall be zinc electroplated, 14 mesh steel screen, arranged in alternate layers of flat and herringbone-crimped screens, 4 layers of each per inch, rod reinforced, and enclosed in a frame of 16 ga. steel with flush mitered corners. Resistance to air flow of a clean filter shall not exceed 0.12" wg at 3.6 cfm per square inch of net face area.

"Holding frames shall be factory built of 16 ga. steel "T" section, bonderized and bake enameled, with felt air seal, interlocking edges, and filter locking device.

"Filters shall be FAR-AIR Type 44 and frames shall be FAR-AIR Standard Interlocking as manufactured by Farr Company, Los Angeles 43, California.

Your air conditioning system depends on proper air filters for its efficient operation and long service life, yet the air filters account for only a small percentage of the entire system's total cost. FAR-AIR filters cost a little more than ordinary types but they are worth far more than they cost because *they have no equal* in efficiency, dirt-holding capacity, ease of cleaning and quality of construction.

Install Far-Air Filters now and take advantage of their over-all economy while enjoying better air filtration. Write for complete information.

Users of FAR-AIR Filters include:

Carnation Co. • Eastman Kodak Co.
Westinghouse Electric Corp.
Monsanto Chemical Co.
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*Trade Mark Reg.

FAR-AIR FILTERS

"Better by Farr"

FARR COMPANY

Manufacturing Engineers

Los Angeles • Chicago • New York

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The Greeks had a word for it... εὐπάθεια!

(comfort)

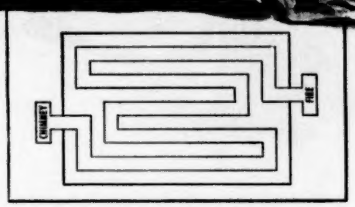
For the "comfort" of radiant heat today steel pipe is first choice—

Self preservation is the first law of nature and man's urge to seek comfort is part of it. Civilizations long extinct knew that, too. The ancient Greeks had a word for it which means the same but doesn't look nor sound as warm and friendly as our own word "comfort."

But in whatever language you say it, one of the ways of attaining comfort is by keeping warm, and the Ancients knew about radiant heating centuries ago. By passing smoke and hot gases from their fires through ditches and ducts, they warmed the floors and radiated heat throughout their homes.

Today radiant heating brings sun-like warmth to every room, in a completely scientific and effective way, by circulating hot water through embedded steel pipe coils. Proved through more than 60 years of service in conventional hot water heating systems, steel pipe has every quality required by modern radiant installations . . . low cost, strength, weldability, formability, and complete suitability.

Yes, if the Greeks had known about it they would have had words to say "steel pipe is first choice," too.



The ancients utilized channels beneath their floors to draw hot gases through from firebox to chimney, as shown above, thus warming floors.

Today steel pipe coils are embedded in floors or ceilings during initial construction to provide advantages of radiant heating.

COMMITTEE ON STEEL PIPE RESEARCH

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The permanence of a STREAMLINE copper system appeals to home buyers. It costs no more, installed, than a rustable ferrous system. It eliminates complaints because it is permanently trouble-free!
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Copper plumbing protects the owner's investment—the resale value of the building is actually better! At no extra cost the owner gets what he wants—a modern, dependable system—rust proof and virtually clog-free.
STREAMLINE
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Copper is already on the critical list. For civilian purposes it will not be as generally available as we would all wish it to be. To get further information see your plumbing jobber. For illustrated product literature write for Catalog S-351 and W-250 describing the complete line of cast supply and drainage fittings and the complete line of wrought fittings through 4".
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Squeeze-easer

FOR TODAY'S HOUSING

Bryant Gas Forced-Air Vertical Furnaces are *your* answer to the important home space problem. They're the long-lived space-savers that can be installed almost anywhere . . . in basement, utility room or small closet. They require only slightly more than two square feet of floor space in their smaller sizes.

They provide the kind of fully automatic, trouble-free operation that pays off in economy and user satisfaction. The proof is in *thousands* of single-family dwellings and in *thousands* of family units of multi-family housing which have Bryant *Personalized Heating* installations.

These slim, efficient Bryant Gas Forced-Air Vertical Furnaces will *fit* any new home or replacement heating need. Sell them to help *ease the squeeze* . . . to provide more space for living. Get full details from the Bryant Distributor nearest you or write direct. Bryant Heater Division, Dept. 164, Affiliated Gas Equipment, Inc., 17825 St. Clair Avenue, Cleveland 10, Ohio.

Let the pup be furnace man . . . and water boy too!

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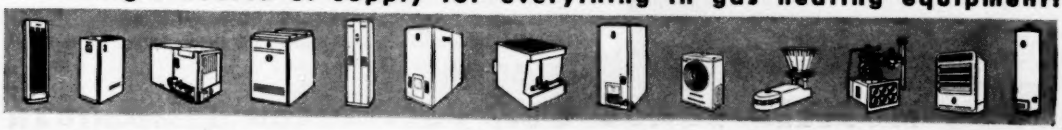
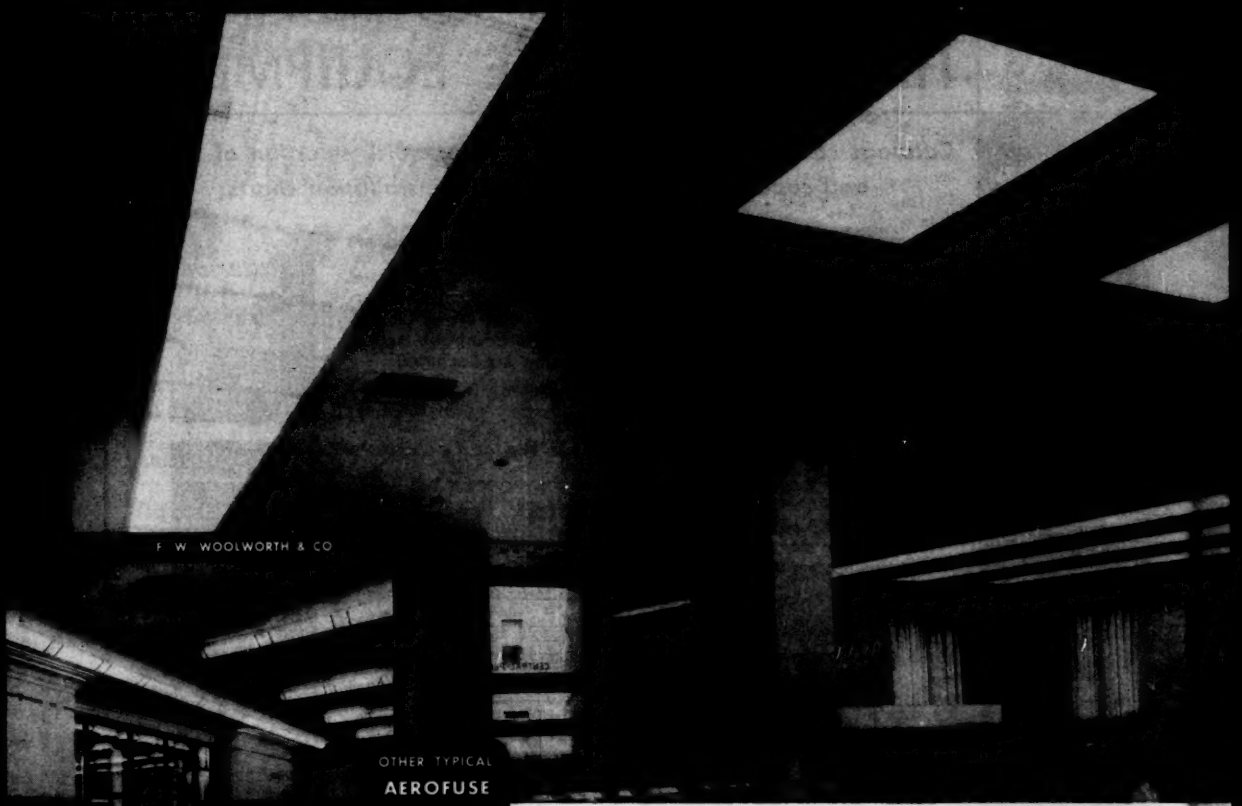


Aerofuse



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Catalogs contain complete information for quick selection of rating and capacities — with designs and installation charts.

p-k Hot Water Storage Heaters and Preheaters

Standard construction details, storage and heating capacities, dimension tables, A.S.M.E. and standard specifications. Vertical units for heater service and Lo Flo boiler water heaters are also described. Typical hot water consumption figures for various types of building application are included.

Catalog No. 17 (20 pp.)

p-k Hot Water Convertors

An aid in the selection of the proper convertor for hot water heating systems. Contains dimension and capacity tables for 2- and 4-pass units for installation in standard and radiant heating systems—for steam pressures from 0 to 15 psi. and water temperatures from 90° to 220° F.

Catalog No. 303 (8 pp.)

p-k Instantaneous Heaters and Heat Exchangers

Selection data on 2-, 4-, and 6-pass "U" tube hot water heaters—capacities from 95 to 101,000 gph.—steam pressures from 0 to 100 psig.—water temperatures from 40° to 100° F. inlet and from 80° to 300° F. outlet. Also covers pressure drops, capacities and dimensions for Condensate Coolers, and Booster Heaters. Typical piping arrangements are shown.

Catalog No. 202 (40 pp.—tab indexed)

p-k Freon Coolers (Water)

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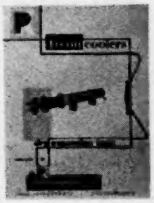
Catalog No. 101 (12 pp.)



Write for the catalog that concerns your heat exchange problem. There is no obligation.

p-k *70 years of heat transfer experience assures you of superior design and construction*

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...a size and type for every purpose

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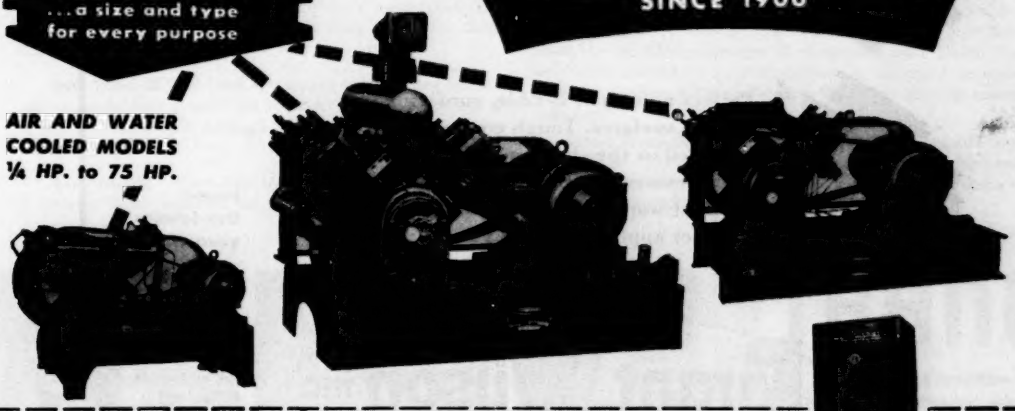
AIR AND WATER COOLED MODELS
¼ HP. to 75 HP.



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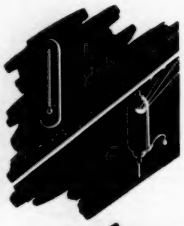
AIR CONDITIONING
Self Contained Units in 4 sizes: 3-5-7½ and 10 HP.
Remote Installation Types from 3 to 75 HP.

...here are the reasons why

Grant Wilson DUX-SULATION
(ASBESTOS PROTECTED)

is BEST FOR DUCT INSULATION



1. High thermal and acoustical insulating properties . . . K factor of .27 BTU and sound absorption approximately 61%. Integral, woven asbestos membrane. ●

2. Easy to handle, easy to install *correctly*, can't be crushed or cracked, springs back to original thickness if compressed. Supplied with special glue and tape, no "fasteners" needed.

3. Constant insulating values. Can't "powder", shift or sift; no thin spots, even at corners. No deterioration of any kind, no *change* of any kind.

4. Perfect adhesion, flexible, conforms to uneven surfaces. Tough enough to be installed in the shop and still withstand all necessary handling. Not just "adapted" for duct work, but specifically engineered for duct application ONLY!

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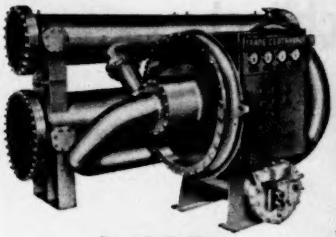
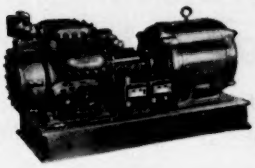
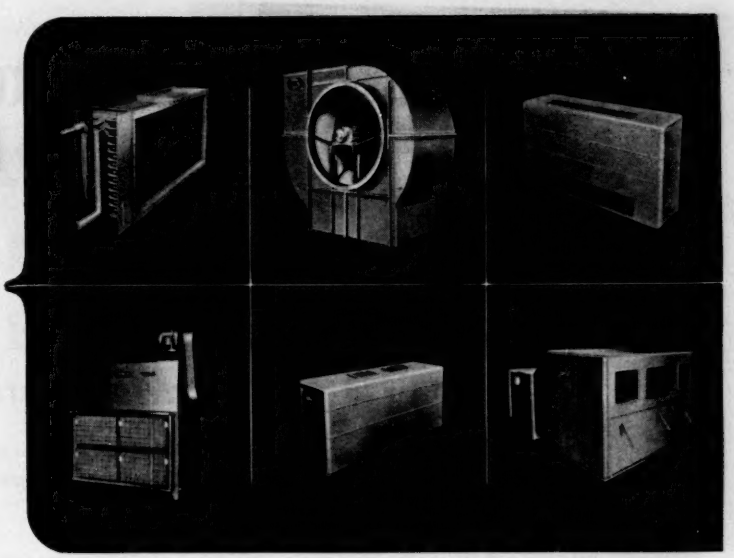


Trane CenTraVac



Trane Reciprocating Compressor



Trane Cooling Coil (above) Trane Centrifugal Fan (above) UniTrane Air Conditioner (above)

Trane Climate Changer Trane Custom Air Unit Trane Multi-Zone Climate Changer

How matched Trane Products make better systems

Here's why more and more people are specifying, installing and using more and more Trane matched products each year.

Specifiers know that Trane manufactures everything from hot water valves to refrigeration units. Using Trane equipment, they can create a wide variety of complete systems for every type of building. They combine Trane Evaporative Condensers with Trane Reciprocating Compressors, Trane Fans with Trane Cooling or Heating Coils, Trane Unit Ventilators with Trane Steam Specialties.

And when they use Trane equipment together, they are not only getting the fine features that have established individual Trane products as leaders in their respective fields but a lot more as well.

Save Time—If they need equipment counsel they see one salesman-engineer instead of several. They use one set of completely integrated catalogs conveniently bound into one handy binder.

Save Trouble—When they use Trane equipment to create a system, Trane assumes the responsibility for the correct performance of all its equipment when properly installed and controlled. There is no blaming the product of one manufacturer because the product of another doesn't operate satisfactorily.

Better Performance, Too—Trane products are designed together, made together, tested together for service together. Each product is built to the same high level of quality. Into each product, Trane has incorporated important construction features that make that product a leader in its field. When these leading products are used together in a system, better performance is inevitable.

Add to all these specific advantages those that the installer enjoys. He orders equipment directly from one supplier. He can plan shipment of equipment more easily. He writes one check for the whole system. Bookkeeping is cut to the bone. So is installation because Trane products fit better together.

When Trane products are used together in complete systems the user gets a better installation. Join those who have already found the advantages of complete Trane systems—specify and install Trane products.

Equipment room of a large office building where Trane centrifugal refrigerating units supply chilled water in an extensive Trane air conditioning system.

This Trane Condensing Unit is perfectly matched with Trane Direct Expansion Coils to form the heart of a Trane system for the coffee shop of a large hotel.

Real Trane product teamwork is illustrated by this complete Trane Compressor, Trane Evaporative Condenser and Trane Climate Changer installation.

TRANE

MANUFACTURING ENGINEERS
OF HEATING, VENTILATING AND
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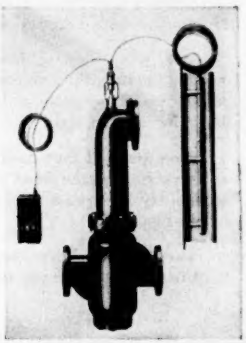

Sarcotherm weather-compensated control valve.

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Maximum strength and endurance to minimize shutdown losses and replacement costs... these are important operating economies you can trace directly to the laboratory safeguards of Ladish Controlled Quality. Advanced metallurgical controls over materials and forging methods assure complete dependability in every Ladish fitting.

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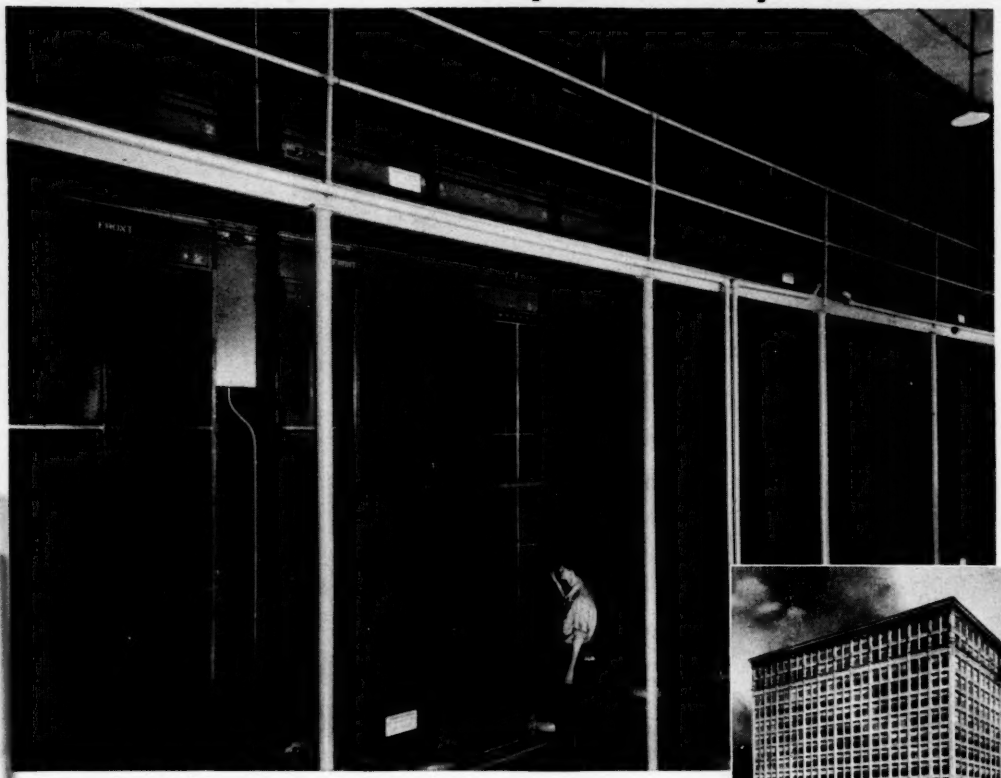

AAF Electro-Matic Air Filter, Kaufmann's Dept. Store, Pittsburgh, Pa.
Air Conditioning Contractors: Carrier Corp.

Electro-MATIC super-clean air

PAYS A PROFIT!

THE AAF Electronic precipitators shown above are part of Kaufmann Department Store's extensive modernization program. Super-clean air as part of the complete air conditioning system installed in this nationally famous store will save thousands of dollars annually in merchandise and will promote sales. AAF's Electro-Matic was specified because of its outstanding performance record in other famous stores such as Best & Co., N. Y., Carson Pirie Scott, Chicago. Foley Bros., Houston, Halle Bros., Cleveland... and many others. Developed exclusively by AAF engineers, the Electro-Matic is the *only* automatic, self-cleaning, electronic precipitator. Widely used in the textile, steel and other industries as well as commercially, the Electro-Matic maintains high efficiency filtration of fractional micron particles such as smoke and fumes, in addition to coarse material. The filters are standardized, self-contained units easily installed in various arrangements to meet any air volume requirement.

Exclusive features of the Electro-Matic are its automatic operation and self-cleaning function. This combination reduces servicing to routine maintenance and insures maximum operating efficiency at all times.

AAF makes the *only* complete line of air filters and electronic precipitators. If you have a problem requiring super-clean air see your nearby AAF representative or write today for our Electro-Matic Engineering Bulletin No. 250-E.

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Every ventilation system must supply a certain amount of fresh air to maintain satisfactory air quality within the conditioned space. But air supplied from the outside must be heated or cooled, depending upon the season. Dorex Air Recovery reduces the amount of outside air required for ventilation . . . thus, substantially less heating and cooling equipment is needed, and critical materials are saved.

The thrifty Dorex C Cell is a simple device that "manufactures" *fresh* air from *used* air by passing it through activated carbon — reducing, by as much as two-thirds, the amount of outside air that has to be taken into the system.

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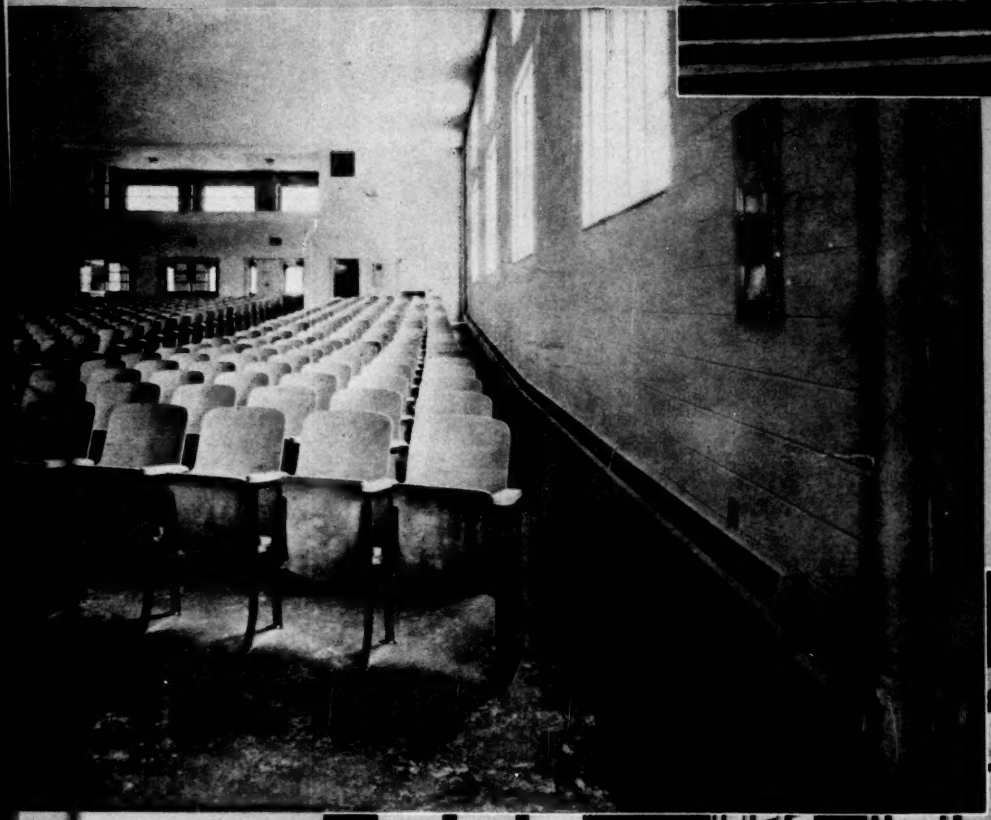
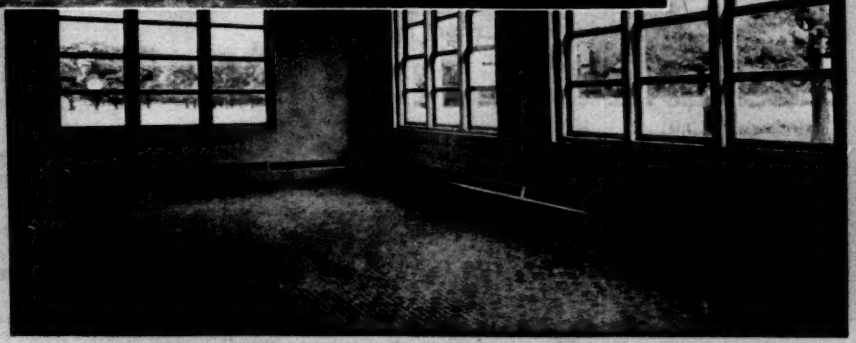
NORFOLK CATHOLIC HIGH SCHOOL, NORFOLK, VA.

Auditorium wing at left, gymnasium wing at right. Cafeteria wing in rear. Under the jurisdiction of the Bishop of Richmond, the Most Rev. Peter L. Ireton. Diocesan superintendent, the Rev. J. Louis Flaherty. Architects: Gleeson and Mulrooney, Philadelphia. Associate Architect: T. David Fitzgibbon, Norfolk. Consulting Engineer: William G. Flurer, Philadelphia. Heating Contractor: Coley and Petersen, Norfolk.



Webster Walvector in auditorium on separate zone, one of five, permits use for evening parish affairs without heating entire school.

Webster Walvector in classroom spreads the heat along outside wall . . no drafts . . no hot spots.



WEBSTER HEATING EQUIPMENT FOR SCHOOLS

RADIATION

Webster Walvector Radiation. Webster-Nesbitt Unit Heaters. Webster System Convector Radiation : : Webster Baseboard Heating

HEATING CONTROLS

Webster Moderator Systems of Steam Heating : : Webster Continuous Flow Hot Water Heating Control : : Webster Control Valves

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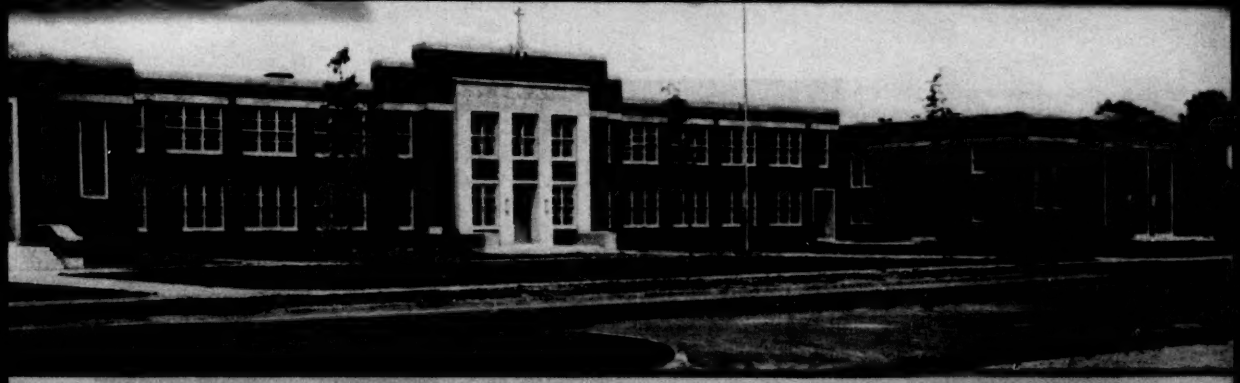

Solves Heating Design Problems in
500-STUDENT HIGH SCHOOL

The designers of the new Norfolk Catholic High School were able to attain long sought objectives by using Webster Walvector Radiation and forced hot water for the basic heating need, supplemented by Webster Convectors and Webster-Nesbitt Unit Heaters.

Economy in first cost was helped by the simplicity of Webster Walvector with its reduction in distribution piping and use of only limited space, well illustrated in the auditorium view at the left.

Comfort was assured by spreading the heat the full length of the outside wall . . . no drafts . . . no hot spots . . . a minimum of covered exposed piping, evident in the class room view at the left below.

Minimum operating costs for the years to come were obtained by division of the installation into five zones and by using Webster-Nesbitt Unit Heaters with separate controls in the cafeteria-kitchen.

This installation has been through its first full heating season and has proved the soundness of the designers' conception. Webster Walvector has been installed in a long list of new school buildings. For information about Walvector and other Webster products for school heating, call the Webster Representative or write us. Address Dept. HV-5.

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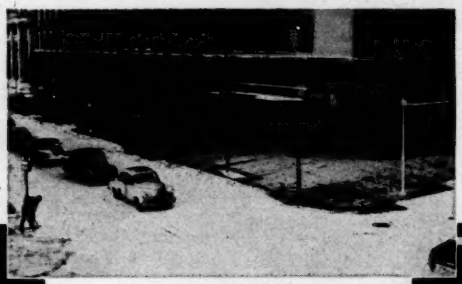
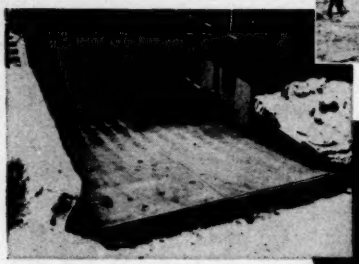
Webster
WALVECTOR
For Steam and Hot Water Heating

Webster Walvector in girls' locker room. Webster Convector in toilet.



COMMERCIAL BUILDINGS



PRIVATE HOMES

CLUBS

FUNERAL HOMES

BANKS

Here's how BYERS SNOW MELTING SYSTEMS Came Through Last Winter's Toughest Tests

Last winter's record-breaking snowfalls gave Byers Snow Melting Systems a real workout. The above illustrations are typical of the results and suggest the wide variety of applications using this modern snow removal method. The coils of Byers Wrought Iron pipe, embedded in the sidewalk or pavement and carrying hot water-anti-freeze solution, made the heaviest snow vanish magically as it fell.

Satisfied users everywhere are constantly adding new chapters to the snow melting success-story. Householders find snow melting an economical luxury. Stores, hotels and service stations have cut excessive snow removal costs and enjoy increases in patronage. Industrial plants keep shipments moving, ban lost time at shift changes by using snow melting systems in loading platforms and access roads. This ever-increasing acceptance is explained by remarkable performance records like those above.

Byers Wrought Iron pipe is ideally suited for this service because of its combination of essential qualities. Its corrosion resistance has been repeatedly proven. Its heat emission is high. It is easily formed and welded. It expands and contracts at virtually the same rate with concrete. And it has ample mechanical strength to withstand damage during installation.

NEW BULLETIN ON SNOW MELTING. This new bulletin covers the entire field of snow melting—design, installation, operation . . . and explains why dependability demands the use of Byers Wrought Iron pipe. Write for your copy.

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WHY WROUGHT IRON LASTS

This notch-fracture test specimen illustrates the unusual fibrous structure of wrought iron—which is responsible for the unusual corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

BYERS

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WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

Washington News

LORING F. OVERMAN

THE National Production Authority has announced that a new Controlled Materials Plan, patterned after the World War II model, will begin on July 1 to channel steel, copper and aluminum into essential uses.

Broadly speaking, the new CMP will regulate the flow of the three key metals into three big economic fields: direct defense, defense-supporting activities, and the expansion of industrial capacity. It will not directly regulate the supply of metals for the durable consumers goods industries, at least not at the start.

The new CMP has been described as a limited Controlled Materials Plan. It does not cut up the whole pie by allocating every scrap of available steel, copper and aluminum. Instead, it will allocate only amounts required by defense-related activities, leaving an uncontrolled area in which civilian enterprises may vie for materials.

The allocated amounts of materials will be assigned to an "A" list (usable only for military purposes, such as tanks or tank parts) and a "B" list of essential items needed for both civilian and defense items. A typical example of a "B" item is a ball bearing, which could be used either in a military machine or in an oil burner motor.

In general, "A" products are those where the most convenient method of production authorization is vertical. Producers of "A" products get their production authorizations and materials allotments from their customer, such as a Government agency. Under the new CMP, the prime contractor would receive his materials authorization from his customer, and would extend his priorities rating on to subcontractors whom he engages to assist him in delivering the finished product.

The "B" list programs will include certain products where it is most practical to furnish authorizations horizontally, direct to the producers. In general, this list will include civilian type products, industrial machinery and equipment, and components that are needed for defense. Producers on the "B" list will obtain their authorization and allotment from their NPA Industry Division.

The NPA, in announcing the plan, said that producers affected by CMP will have plenty of time to brief themselves on procedures and regulations and be ready to operate under the Controlled Materials Plan after July 1. Forms, operating instructions and an official "B" list were scheduled to be available about May 1—giving persons affected approximately two months to prepare.

A tentative "B" list, published as a guide, contained the following items of direct interest to the heating, ventilating and air conditioning industries: pumps and compressors, fans and blowers, heat exchangers, condensers, motors, switch gears and electrical control apparatus, tanks, boilers, valves and fittings, mechanical stokers, refrigeration and air conditioning equipment (except household refrigerators and comfort air-conditioning equipment), electrical measuring and indicating instruments, insulation, and oil burners.

The foregoing are items for which materials allocations will be made under the Controlled Materials Plan. Priorities ratings may be required of those who purchase "B" list articles. Thus, defense industries and defense-supporting industries would stand first in line to take delivery of such products. No decision has yet been made as to the relative essentiality of industries not directly connected with defense activities.

The National Production Authority emphasizes that details of the CMP have not all been worked out, and that the initial announcement was intended merely to inform industry of the government's intentions. During May, seven orders were scheduled to be issued to implement the program, as follows:

1. General rules for operating CMP.
2. Inventories—these are already covered in NPA Reg. 1, and the CMP Order will be superimposed.
3. Preference Ratings.
4. Warehouses.
5. Maintenance, Repair and Operating Supplies—will supersede NPA Reg. 4.
6. Construction.
7. Repair Shops.

NPA officials have indicated that abuses of Reg. 4, the current MRO order, hastened the decision to put the CMP program into operation. Under Reg. 4, all business firms were permitted a DO-97 rating to assist them in purchasing maintenance, repair and operating supplies. Under the existing single band priorities system, these MRO ratings were as potent as the most urgent military rating. As a result, suppliers were faced with mountains of rated orders calling for many times the normal amounts of MRO materials.

One of the seven new CMP orders will solve that problem by allocating specific amounts of steel, copper and aluminum to produce all MRO items which are known to be stock products. In addition, there will be an allocation to some 40,000 repair shops specializing in producing MRO items which cannot be obtained from stock.

What Next Under CMP?

The first phase of CMP will be the reporting to NPA, by producers, of detailed requirements for the three basic metals on forms which will be made available in May. The second phase will be the allotment of specific amounts of these materials to producers, starting July 1. It is planned that after the first quarter of operation CMP will be decentralized, since experience in the last war showed that in the great majority of cases CMP authorizations and allotments were best handled through field offices. If this materializes, producers for the most part will apply to their local field offices, cutting down the necessity for liaison with Washington.

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Rolled-in or Welded Tubes
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These are only a few of the features and advantages that have made ACME Condensers the choice of the heavy refrigeration Industry for quality, design and lasting performance. Write for catalog on equipment you require.

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Dry-Ex* Water Coolers • Hi-Peak* Water Coolers • Flow-Cold* Liquid Chillers • Fin Coils • Cooling Towers • Oil Separators • Liquid Receivers • Heat Exchangers • Bio-Cold* Industrial Unit Coolers • Flow-Cold Refrigeration Units • Convectors

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ACME INDUSTRIES, INC.
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continuously serving the refrigeration industry since 1919

CMP and Construction

In the press conference at which CMP plans were announced, NPA Administrator Manley Fleischmann was asked, "How do you propose to provide materials for essential construction, such as highways, schools, hospitals, and these plant expansions?"

"We will have to do it substantially as it was done during the last war," answered Mr. Fleischmann. "Basically, the question in construction today is structural steel. I see no other way to do it than to take the large industrial construction projects and review them here, just as was done in World War II; and make a specific allotment to those most needed.

"Now in all probability we would have a free area in which, for example, the schools could be constructed. This is one of the borderline areas on which we haven't made a decision, or we would make an allotment for school building purposes, and then obtain the advice, for example, of the United States Office of Education as to the best use for that comparatively limited amount. For example, at the Savannah River project you are obviously going to need new schools. They are just as essential as the project. I think we will have to provide an allotment for essential school building."

Mr. Fleischmann indicated that the same yardstick would apply to roads, with repair and upkeep given priority. As for residential construction, the NPA has no program at this time.

NPA Reorganized

To handle the new Controlled Materials Plan, the National Production Authority has been broken into four bureaus: Metals and Minerals; Industrial and Agricultural Equipment; Textile, Leather and Specialty Equipment; Chemical, Rubber and Forest Products.

Under the new organization there will be 35 industry divisions in place of the present 20 divisions now located in the Bureau of Industry Operations. Many of these have been formed by the split-up of the Machinery Division of NPA, and the changes will make possible close working relationships between officials and industry executives in carrying out the CMP.

The Bureau of greatest interest to the heating, ventilating and air conditioning industries will be the Metals and Minerals Bureau, headed by Norman Foy, on leave as general manager of sales for the Republic Steel Corporation. Mr. Foy was director of the WPB Steel Division during World War II. Divisions under Mr. Foy will be Iron and Steel, headed by Melvin Cole, Bethlehem Steel Corp.; Light Metals (aluminum and magnesium), Nigel Bell; Copper Division (chief not named); Miscellaneous Metals and Minerals, Frank H. Hayes; Tin, Lead and Zinc, Whitman W. Hopton.

In addition to the four new bureaus, two others of interest to H & V readers are the Facilities and Construction Bureau, headed by Frank Creedon; and the Policy Coordination Bureau, headed by Dean O. Bowman.

Four other operating units complete the NPA organization. They are:

The Office of Small Business, headed by John G. Pritchard, which represents the interests of smaller companies in obtaining defense contracts, in utilization of their plants in the manufacture of defense and civilian goods, and in assuring small manufacturers a fair share of materials in short supply.

The Office of Civilian Requirements, headed by Lewis Allen Weiss. This group is responsible for supplying the country's fundamental needs for civilian goods and services, and acts as claim agency for all agencies of state and local government and for special needs, such as schools and hospitals.

The Office of Labor Requirements; no chief has yet been announced. The task of this group is to act as a liaison agency with all other government agencies having responsibilities involving manpower or industrial relations.

The Office of Field Services, which provides information and assistance to business locally, and administers NPA orders and regulations in the field. Head of this office is Carleton Hayward.

In mid-April the Defense Production Administration made its first allocation of steel, copper and aluminum for June for emergency school and hospital construction. The program provides 41,000 tons of steel, 1,500,000 pounds of copper, and 170,000 pounds of aluminum. Actual application for an allotment will have to be made to the Office of Materials Requirements, Federal Security Administration. Instructions and procedures for filing applications are to be issued shortly.

The allocation was a part of a program which made available approximately 1.4 million product-tons of steel for the month for 24 special programs needed to expand production for defense-supporting and essential civilian needs. Similar allocations for May totalled 1.2 million tons for 19 programs.

New Index of Purchasing Offices

The Munitions Board, Department of Defense, has issued a revised "Index of Military Purchasing Offices." The index is intended as a guide to industry in selling to the military departments of the government. In pamphlet form, the index lists commodities as well as the governmental purchasing office to which they are assigned. The new edition lists all commodities which had been assigned by January 1 to one or more of the three departments for centralized procurement.

Copies of the Index may be secured from the Central Military Procurement Information Office, Munitions Board, Department of Defense, The Pentagon, Washington 25, D. C.

Taking Up Slack

One of the toughest problems of the defense program, it appears, is in timing controls on scarce materials to coincide with the changeover from civilian to defense production. On April 20, about the time NPA was announcing plans to invoke a third-quarter CMP, the agency also relaxed restrictions on aluminum —one of the three basic metals covered by the Controlled Materials Plan. Under Order M-7, NPA had planned to cut off the use of aluminum on May 1 in the manufacture of some 200 civilian items.

BRIEFLY STATED

• General Electric Co. engineers can solder glass to metal in a process which makes a bond stronger than the glass itself. The method, which can also be used to solder metal to ceramics and carbon, was originated by scientists of the G-E Research Laboratory, and is currently being tested for industrial applications by the company's General Engineering Laboratory. The glass and metal areas to be soldered are painted with a thin layer of titanium hydride, and solder is placed upon both painted areas. The parts are placed together and then heated under a vacuum. When the temperature reaches about 900F, the titanium hydride decomposes. This causes the solder, which has already become molten, to adhere to the titanium-painted areas of both glass and metal. A strong, tight bond is formed upon cooling. By using soft metal solders, it is possible to subject this glass-to-metal seal to rapid temperature changes without danger of cracking, despite the wide difference in temperature expansions between glass and metal. This is possible because the differences in movement are absorbed by the solder.

• Manufacturers' shipments of porcelain enameled steel plumbing fixtures during the fourth quarter of 1950 were valued at approximately $18½ million, according to the Porcelain Enamel Institute. Bureau of Census figures show this to be a slight increase over the third quarter of 1950 and a dollar increase of 50% over shipments during the fourth quarter of 1949. Steel plumbing fixture shipments accounted for 19% of the plumbing fixture industry's fourth quarter total.

• Allegheny County (Pittsburgh, Pa.) is the first municipality to take out a sustaining membership in the Air Pollution and Smoke Prevention Association of America.

• Cecil Boling, associated with Bush Manufacturing Co. for the past eleven years, has been elected vice president and general manager. During the time Mr. Boling has been connected with the company, he has acted as sales representative for Bush in its eastern territory, operating through his own organization, the Cecil Boling Co., with headquarters in New York City.

• Captain Thomas H. Urdahl, USN (ret) has been elected vice president of the W. B. Connor Engineering Corp., Danbury, Conn., manufacturers of air conditioning and ventilating specialties. Captain Urdahl has been active in the development and design of electrical and power equipment and systems, especially in the field of heating, ventilating and air conditioning, over the past twenty-five years.

• C. A. de Vyver, Cherry Street, Katonah, N. Y., has been appointed manager for insulations of Johns-Manville.

• John E. Haines has been named president of the recently formed appliance controls division of Minneapolis-Honeywell Regulator Company, C. B. Sweatt, executive vice president, announced. Mr. Haines continues also as vice president of the company in charge of the commercial controls division. The new division, with plants and offices in Los Angeles, manufactures, primarily, controls for domestic hot water and space heaters.

• The Technical Committee of the Cast Iron Soil Pipe Institute has decided upon specifications for a product to be known as service weight soil pipe, which will ultimately supersede the present victory weight pipe. Meanwhile, victory weight pipe will be applied to requisitions on hand, to the extent of producers' abilities. As and when service weight pipe is available, the same will be interchangeable with victory weight pipe and fittings which are in the stocks of distributors and contractors at that time.

• Engineers of the Westinghouse Electric Corp. have developed an air-to-air heat pump and air conditioner. Still in the experimental stage, it may provide winter heating and summer cooling for mild-climate homes of the future.

• Proof that it can take over three times as much feed to put 100 pounds of weight on a hog at 85 degrees as it does at 60 degrees was offered by John L. McKitrick, Agricultural Consultant for the Reynolds Farm Institute, in a recent speech in Chicago before the American Society of Agricultural Engineers. "California investigators found that some hogs needed about 400 pounds of feed to put on 100 pounds of gain when the thermometer read 60 degrees," said Mr. McKitrick. "At 85 degrees it took over three times that much feed, or 1,300 pounds to register the same gain."

• Appointment of Carroll M. Baumgardner as consultant to the Heating Branch, Building Materials Division, National Production Authority, U. S. Department of Commerce, was announced in April.

• Minneapolis-Honeywell Regulator Co. announces completion of an arrangement to perform consulting services to the Atomic Power Division of Westinghouse Electric Corp., Pittsburgh, Pa. Under the agreement, according to James H. Binger, general manager of Honeywell's Valve Division, Honeywell engineers will act as consultants in valve problems arising in the Westinghouse program.

• Map-reproduction van-type bodies mounted on standard military truck chassis carry individual heating and air-cooling systems developed at the Engineer Research and Development Laboratories, Ft. Belvoir, thus permitting use of lithographic process in arctic areas at temperatures down to —70F. Main component is an S-200 Series Janitrol gasoline-burning aircraft heater with maximum output of 200,000 Btu per hour, capable of bringing the van interior to 65F within one hour from a cold start at —70F.

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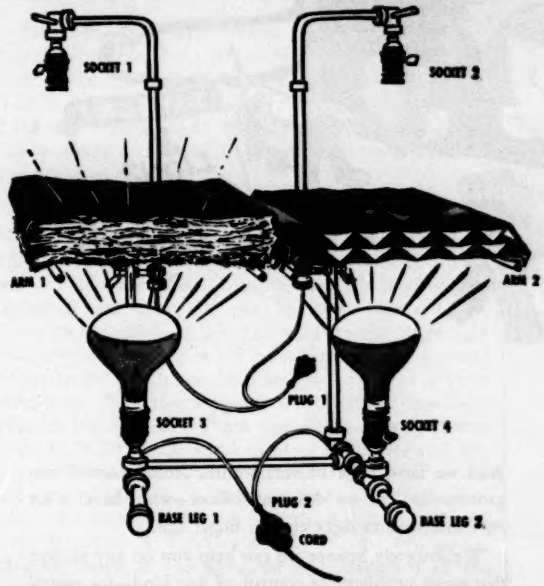

Multiple sheet accordion aluminum cellular insulation is also completely impervious to vapor, will not form condensation nor retain moisture. Its ZERO permeability will force out fortuitous vapor. Safeguards against moisture damage; is an efficient fire stop.

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And we have a lot of very well-informed control engineers—in our 89 different offices—who have a lot *more* information right at their finger tips.

We sincerely believe we can help you on any project that poses problems of control of any kind—for *control* is Honeywell's business.

So, why not *talk to Honeywell?* Why not *write* to Honeywell for complete information on the equipment discussed across the page? And why not do it *now?*

MINNEAPOLIS
Honeywell
First in Controls

• Construction activity rose seasonally in March to round out the largest first-quarter volume of new construction on record, the Building Materials Division, U. S. Department of Commerce and the U. S. Labor Department's Bureau of Labor Statistics reported in April. The total value of new construction put in place during March was estimated at $2.1 billion, 10% above the February estimate and 21% more than the total for March 1950. A summary for the first quarter of 1951 placed the total value of new construction work at $6.1 billion, 21% above the total for the first three months of last year and the largest first quarter total on record. The total value of private residential building activity during the month rose slightly to $848 million, 14% above the corresponding figure for March 1950 when the present housing boom was in its early stages. Further expansion of industrial and commercial building activity took place in March. The dollar value of industrial building was double that of a year ago. Public utilities expanded their construction operations seasonally and there also were increases in highway and conservation work by public agencies.

• Clinton F. Hegg, assistant to the general manager of industrial sales for Libbey-Owens-Ford Glass Company, has been transferred to the company's new Fiber Glass Division as sales manager. The first factory unit of the new division is at Parkersburg, W. Va. Alterations are now under way to prepare for installation of fiber glass equipment.

• Arno C. Fieldner, associated with the Bureau of Mines for over four decades and internationally known inventor and developer of techniques for testing and analyzing coal, coke and gas, has been named Chief Fuels Technologist on the staff of Director Boyd. He will serve as adviser, technical specialist, and general authority for the Bureau on scientific problems in fuels technology. For many years, Dr. Fieldner has been chief of the Bureau's Fuels and Explosives Division. Louis C. McCabe, assistant chief of the Fuels and Explosives Division for two years and also chief of air and stream pollution prevention research for the Bureau, was promoted to chief of the Fuels and Explosives Division in Washington, D. C. He will advise Director Boyd in the planning and execution of the Bureau's broad program of research and experimentation in fuels utilization, petroleum and natural gas, helium, coal, and explosives.

• The Federal Power Commission heard testimony in April concerning the proposal to authorize the Delaware Power and Light Company to substitute straight natural gas for the mixed gas now being served. It plans to purchase the gas from Transcontinental through a ½ mile connection to be constructed. Delaware's plans may be delayed somewhat, however, as certain southern gas distributors contend that they have prior claims to Transcontinental's additional gas, and some question has been raised as to the adequacy of reserves to supply the new markets beyond the fifth year.

In apartment buildings, for example . . .

Question: Is there any way to control the temperature in an apartment building so that all tenants will be satisfied at the same time?

Answer: There certainly is—by installing Honeywell Personalized Heating Control. With PHC, each apartment has its own individual thermostat—so each tenant can select the temperature most comfortable for him.

Question: But we've got to consider fuel bills. Won't they go up—with tenants free to regulate their own heat?

Answer: On the contrary, they'll go down—as much as 20% annually! Surveys show owners often have to overheat a whole building to satisfy the 10% who like to live at 76°. Yet, most tenants want no more than 72°. Their PHC will regulate to that temperature—and save your client money.

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Answer: Initially, Personalized Heating Control does cost more—although probably less than you think. But PHC is *not* just an added cost. It's an *investment* that pays definite, worth-while dividends. Experience has shown tenants will gladly pay a little extra for the greater comfort individual controls give. In just a few years this extra will pay for the installation. And from then on, added income will benefit your client.

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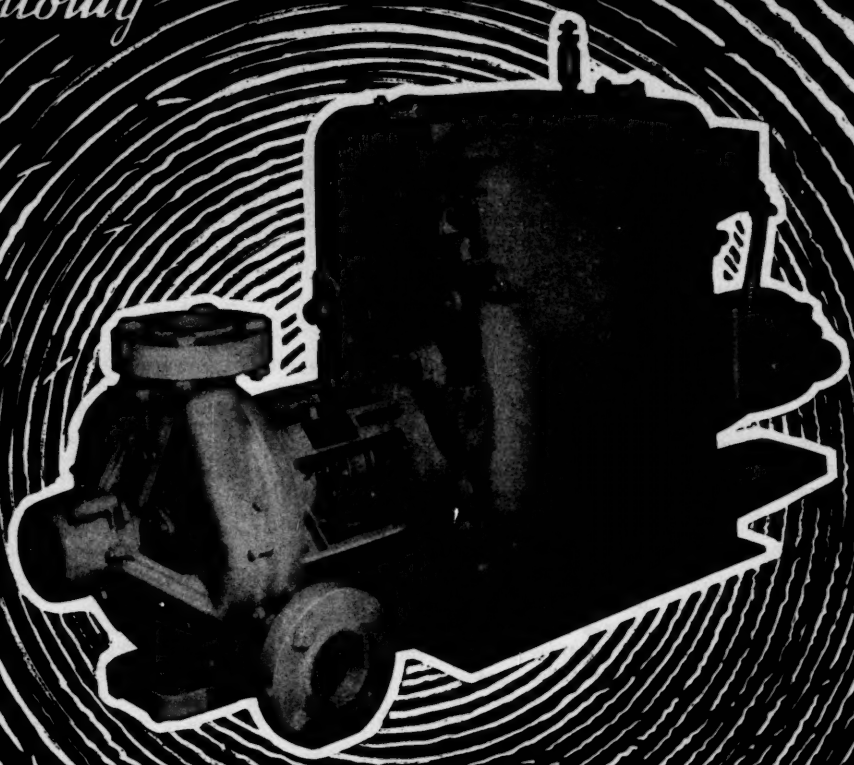

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More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

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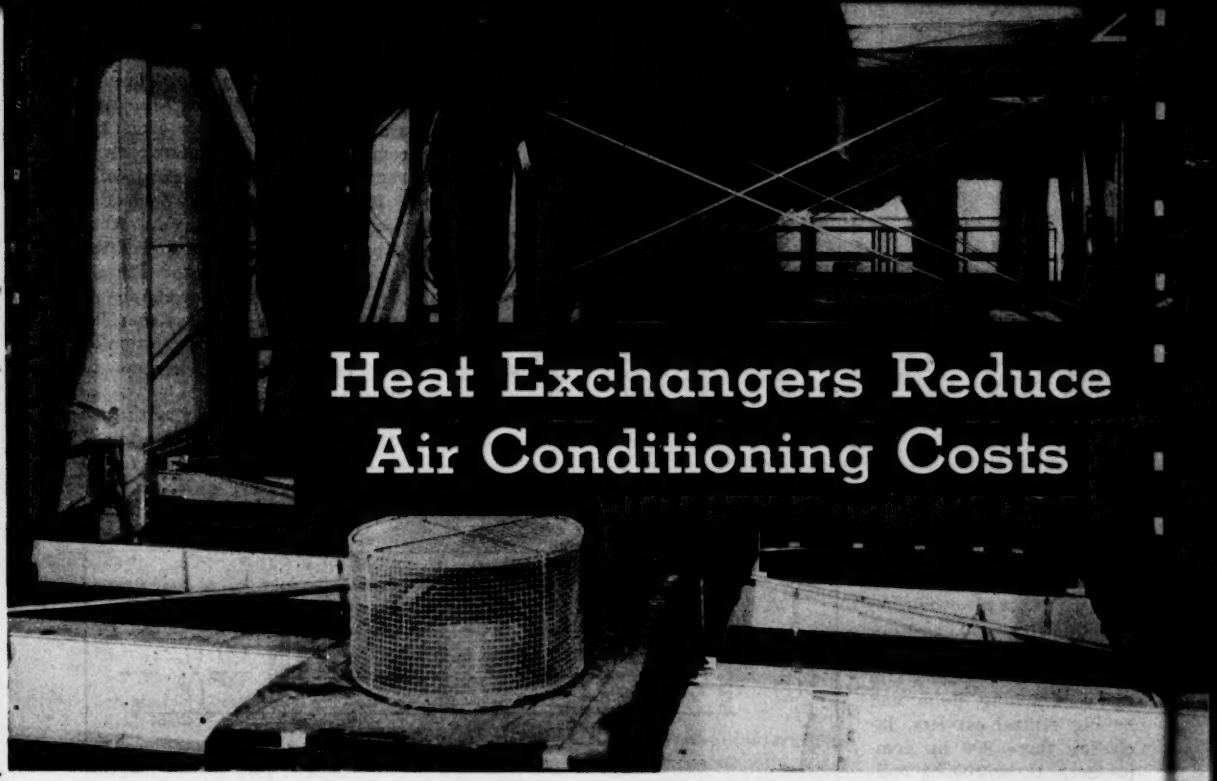


Heat Exchangers Reduce Air Conditioning Costs

ALLEN H. GIPSON
Engineer, Factory Planning, Western Electric Co.
Allentown, Pa.

An analysis of the operating savings possible through the use of a heat exchanger to cut cooling and reheating costs. Several systems are illustrated.

EXTERNAL reheat can be largely eliminated from conventional air conditioning systems by the use of simple heat exchangers. The heat exchangers required to effect this saving are so placed as to absorb heat from the warm return air and to deliver this heat to temper the cold air leaving the dehumidifying coils.

The heat exchangers can be of either the direct or indirect type. The direct type functions by bringing the two temperatures of air to opposite sides of metal separators. An example of this type can be found in boiler installations where heat exchangers are used as air preheaters. In these installations the heat exchangers are built like tubular steam boilers, with the hot flue gases passing through the fire spaces and the air to be heated passing through the water spaces. For air conditioning service the absence of high pressure and temperature makes a flat plate exchanger practical. This flat plate exchanger operates on the same principle as the tubular exchanger but comprises a series of parallel plates about an inch apart, with the warm and cold air passing through alternate spaces.

The indirect type of exchanger performs the same function as the direct type but operates by circulating liquid in coils mounted in the warm and cold air ducts. In passing through the warm duct the liquid picks up heat that is carried to the cold duct where it is imparted to the cold air.

In most applications the direct type exchanger will give greatest advantage, for the only power needed to operate it will be that required to overcome the drop in air pressure through the heat exchanger. This direct type is inherently somewhat more efficient, lighter in weight, and free from the possibility of leaks and freezing. The very real advantage of the indirect heat exchanger lies in its space economy, and this in many installations is a sufficient incentive to indicate its use.

Heat Exchanger Control

Control of the heat exchangers is affected by thermostats that come into play when the air between the heat exchangers and the final reheat coil approaches the required control temperature. In the case of the direct exchangers, this thermostat actuates a damper motor which gradually opens dampers in a by-pass of the heat exchanger. In the indirect exchanger system the thermostat controls the flow of water in the coils. This can be done by either changing the pump speed or by throttling with a motor-operated valve. In the most effective system, a two-position relay will assure that the steam or electric reheat is completely off before the dampers start to open.

TABLE 1—DATA USED IN STUDY FOR USE OF HEAT EXCHANGERS.

Sampling	Unit of Measurement	Outside Air (1)	Return Air (2)	(1) and (2) Mixed (3)	Heat Exchanger to Cooling (4)	Cooling to Heat Exchanger (5)	Heat Exchanger to Reheat (6)	After Reheat (7)
Dry bulb	Deg F	80	80	80	66.9	50	61.9	62.8
Wet bulb	Deg F	72.6	67	68.5	64.8	50	55	55.5
Rel. hum.	% Sat.	68	50	55	85	100	65	63
Density	Ft^3/lb	13.94	13.85	13.87	13.55	12.99	13.3	13.33
Moisture	Gr/lb	107	78	86	86	53	53	53
Dew point	Deg F	69	60	63	63	50	50	50
Volume	CFM	18M	54M	72M	....	....	....	....
Weight	Lb/min	....	....	5,191	5,191	5,166	5,166	5,166
Total heat	Btu/lb	36.2	31.5	32.7	29.7	20.2	23.2	23.5

The proposed systems were worked out as a part of an analysis of the air conditioning of a 375 by 450 two-story and mezzanine factory building served by ten 72,000 cfm air conditioning units and having central services, including three 800 hp compressors, three 300 hp boilers, and three induced draft cooling towers.

A typical though simplified air conditioning unit of this building is shown in Fig. 1, and data for consideration of the conversion is shown in Table 1.

For example, the direct heat exchanger shown in the schematic diagram illustrates how a controlled part of the dehumidified air goes through one set of heat exchanger passages before it reaches the steam reheat coils. It also shows that all of the warm air is going through the other passages of the exchanger where it gives up some of its heat. This loss of heat by the warm air reduces the load on the cooling system and the heat itself, after passing through the metal of the heat exchanger, is picked up by the cool air which becomes warmer and therefore reduces the load on the steam reheat coils.

It will be noticed that Table 1 is predicated on a typical day rather than on a design day and that the air entering the unit and the air leaving it have the same characteristics regardless of the system. The air leaving the cooling section is also unchanged from system to system.

The economy achieved by the use of a heat exchanger is determined by a comparison of the air fed to the cooling section with and without the exchanger. In the table,

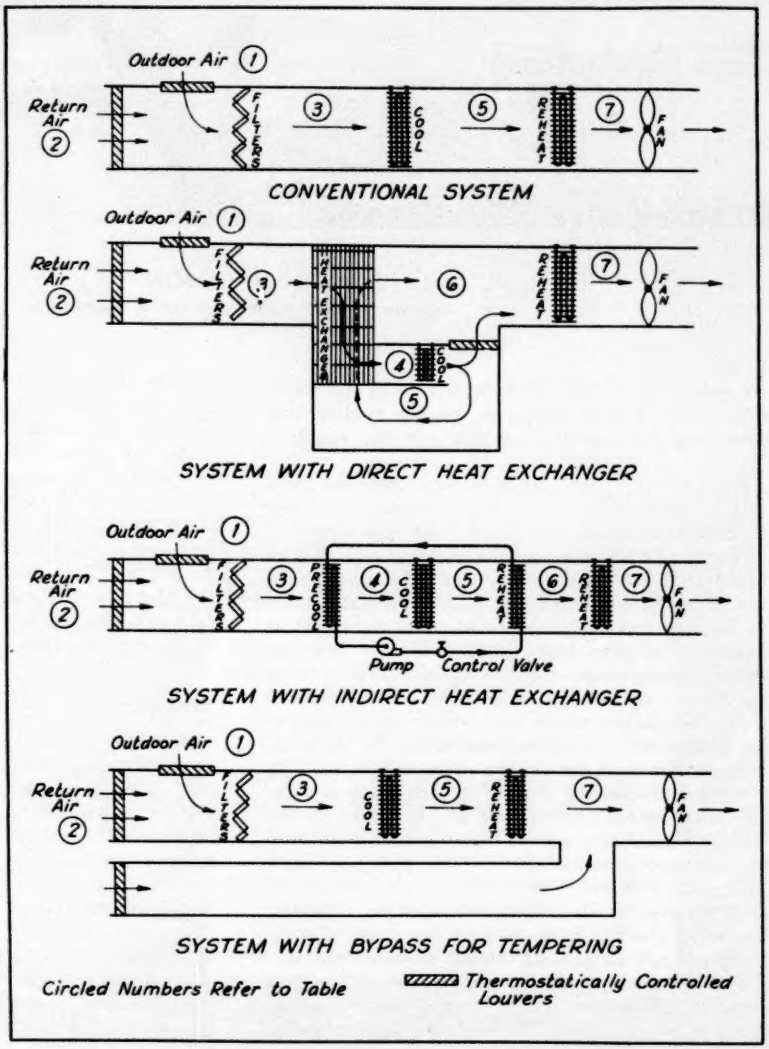


Fig. 1. Schematic diagrams of various systems for reducing heat required for tempering. The conventional system and the one with the by-pass for tempering are the same in over-all thermal characteristics. The system with the direct heat exchanger shows an approach to counterflow which is most desirable in good heat exchanger design.

subtracting the heat of the air in Column 4 from that in Column 3 shows that 3 Btu per lb is saved. In this ten-unit 720,000 cfm system, the saving equals 9.3 million Btu per hr or 25,000 ton hours per week if the system is operated 12 hours per day and 5 days per week with a 50% load factor in the heat exchangers.

Estimating six cents per ton hour of refrigeration, the 25,000 ton hours thus saved would save $1,500 per week. To this can be added the savings on reheat. An exact heat balance is achieved in the exchanger so there will be another saving of 9.3 million Btu per hr which, again including the 50% load factor, gives a weekly saving of 280,000 pounds of saturated 60 pound steam. In the plant under consideration the total steam cost is $1.08 per thousand pounds which would give a round number saving of $300 per week for steam costs and a total of $1,800 for steam and refrigeration costs. The six cents per ton hour and $1.08 per thousand pounds of steam include capital and attendance charges that would not be materially affected by conversion. These charges represent about 25% of the total which would reduce the weekly saving to $1,350.

Of course the proposed system is applicable only to air conditioning units in which dehumidification is required. In the system which the table describes there is a fairly heavy dehumidification load, as the plant's full staff is about 2,500 persons. There are many processes requiring steam or hot water washing and the general processes on the plant require that the relative humidity never exceed 50%.

As attractive as the savings for this building are, they would be exceeded by the savings in a new building where the heat exchangers would allow a reduction in the installed tonnage of refrigeration with associated savings in cooling towers, piping systems, cooling coils, etc. Perhaps the most attractive use of the exchangers would be their installation to correct systems that have proven inadequate because of design errors or because of changes in occupancy.

Types of Exchangers

The direct heat exchangers themselves may be of two types; they can be a series of parallel metal plates, Fig. 2, or they can be made of tubes within a sheath. Whichever way they are made, the arrangement should be such as to provide counterflow and the spaces handling the warmer air should be drained so that if the dew point is passed the condensation will not damage either the heat exchanger or the building.

In the system illustrated on page 71, refrigerated, dehumidified and steam tempered air goes down through ceiling diffusers to the production area. Here the air picks up heat and humidity, and is returned to the truss space through the wire-covered ceiling vents. The truss space serves as a return plenum.

When the system of heat exchangers was first proposed, several air conditioning people confused it with the more usual by-pass system in which a controlled percentage of the air handled by-passes the cooling coils. The purpose of the by-pass system is to temper the air being supplied to rooms and thus prevent the sensation of drafts in the conditioned spaces. It has been rendered largely obsolete by the introduction of

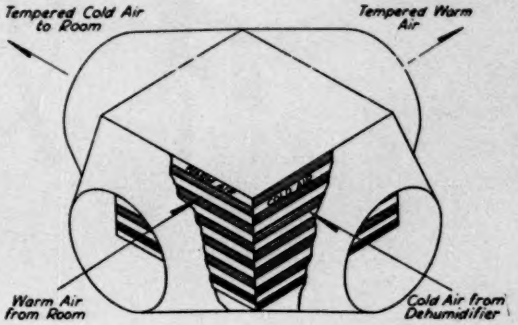


Fig. 2. Direct type heat exchanger designed to eliminate external reheat from air conditioning system. It absorbs heat from return air and delivers it to dehumidified air too cold for room use.

diffusers with secondary air characteristics and it does not save either refrigeration or reheat. In fact, it necessitates additional power because of the additional air handled. The system here proposed processes all air handled, allowing only a partial by-pass of the heat exchanger and that only when the air has reached a desired delivery condition.

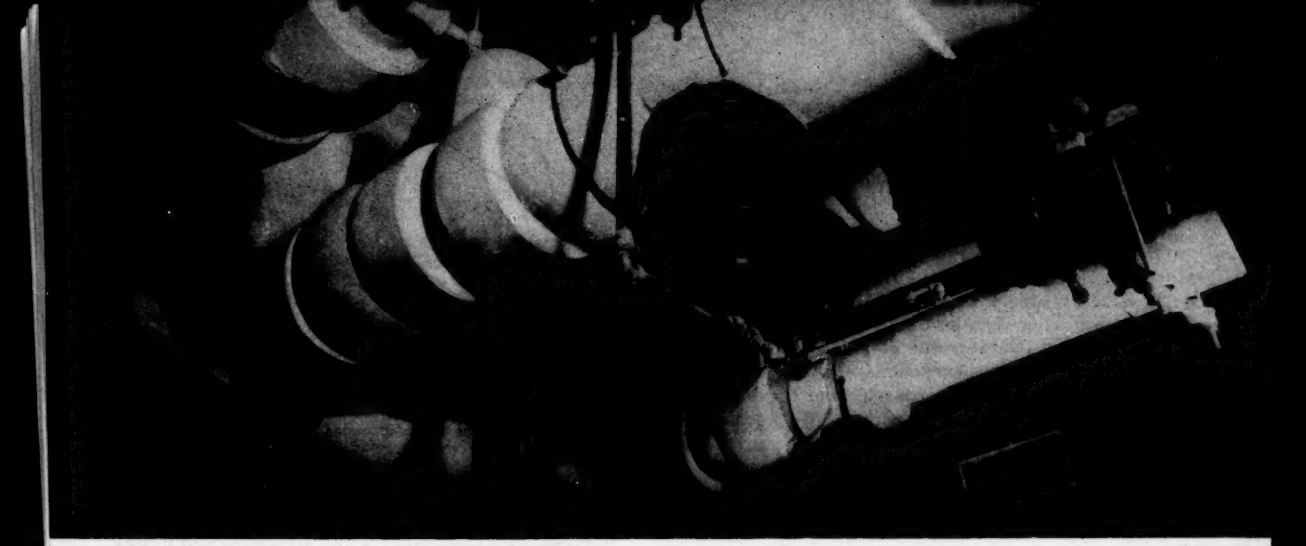
Other Considerations

Other possible sources of "free" heat were considered as part of the study of eliminating reheat. They included the use of the waste heat from the air conditioning equipment, the use of the heat of the water going in the cooling tower, and the use of waste heat from manufacturing processes. Although all the operating personnel would be delighted to part with the heat in the compressor room its use proved impractical and the use of the waste heat from manufacturing processes was likewise impractical because the greatest heat producers in the process did not operate on a sufficiently regular schedule.

Using the water going to the cooling tower for reheat purposes was particularly attractive because on humid days when most reheat was required, the lack of evaporation was causing the cooling towers themselves to be least effective. Use of this heat could effectively eliminate the need of boilers for reheat but the cost of installing the necessary equipment would be comparable with the cost of installing the heat exchangers and the double savings of the heat exchangers proved greater.

If well water, available in good supply and very cold, could be used for precooling of the air going to the cooling coils, a substantial saving in compressor load would be achieved. This possibility as well as the possibility of using well water for cooling was considered to be contrary to the public interest as expressed in the water conservation programs now so important to our national economy.

The general conclusion of the survey was that heat exchangers should be used and should be installed in the air conditioning system as soon as practicable. It is also recommended that in any future air conditioned buildings, heat exchangers should be considered.



Piping Insulation Problems of Open Structures

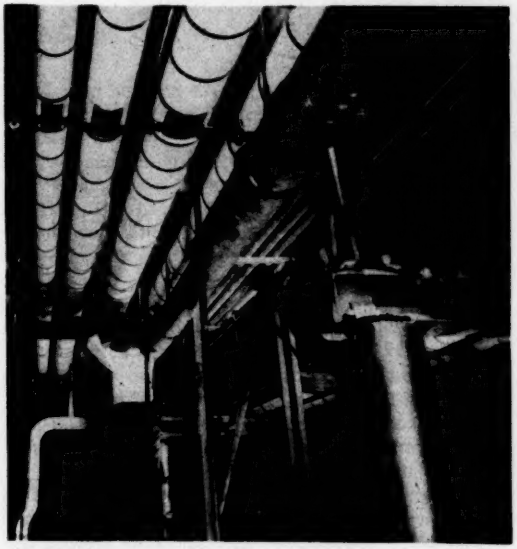
As Handled at Port of New York Authority Bus Terminal

BUILDINGS with open areas, such as bus and freight terminals, warehouses, stations, yards, etc., where heated lines are partially exposed to the weather, present special insulation problems. Because of low temperatures and high air velocities, thicker insulation than would normally be used on indoor lines is required. To prevent possible freezing, even condensate return lines must be completely insulated.

A case in point is the new Port of New York Authority bus terminal in Manhattan. The $24,000,000 structure, built by The Port of New York Authority, is 800 ft long, 200 ft wide, and 62 ft high, and is designed to handle more than 2,500 buses daily. It has 5 levels, a long distance bus level, main concourse, suburban concourse, suburban bus level, and public auto parking for more than 450 cars on the roof. There is a basement, at one end of the structure, below the long distance bus level. A 1,500 ft overhead ramp connects the west end of the terminal with the Lincoln Tunnel.

An 8-inch main from the New York Steam Corp. supplies saturated steam at 135-140 psig to the steam meter room, located on the long distance bus level, at the east end of the building. The main increases to 10 inches as it leaves the steam meter room, and then goes to the east equipment room, located some 50 ft away from the meter room. A take-off from the high pressure main in the east equipment room runs the length of the building to the west equipment room.

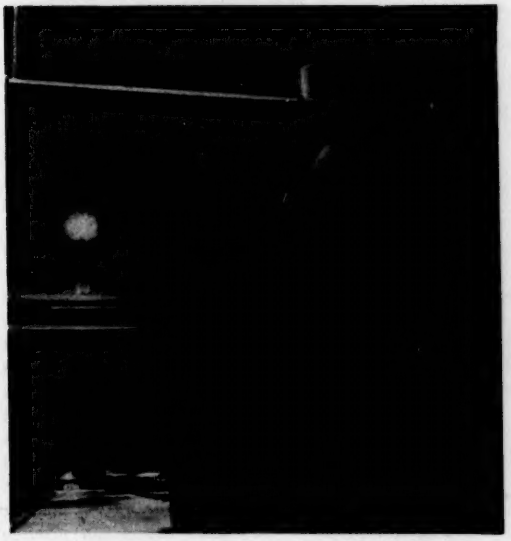
Each equipment room heats one-half of the structure. In these rooms, which contain reducing stations, hot water tanks, air conditioning equipment, and other equipment, the steam is reduced to 10 to 15 lb, and to 5 to 10 lb. Steam at 10 to 15 lb is supplied to unit heaters, the heating coils on air conditioning equipment, and to the steam tracer piping on fire and water



Steam lines, in furred ceiling above bus platforms, covered with 85% Magnesia and banded canvas jacket.

Insulation Thickness Schedule

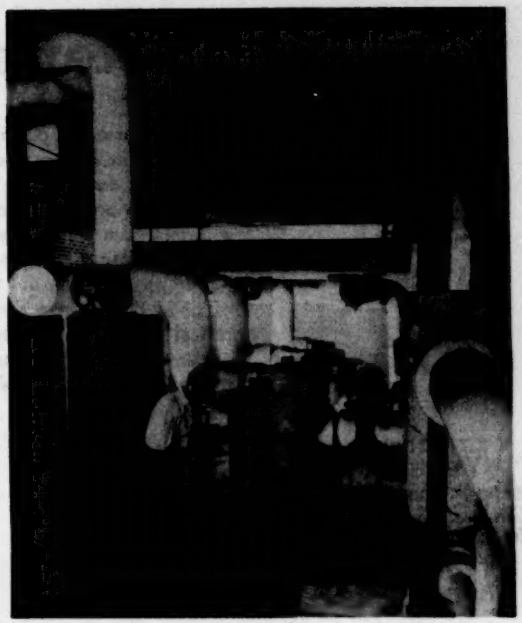
Equipment	Insulation Thickness (Nominal, Inches)
High pressure piping	
larger than 1½ in.	2
1½ in. and smaller	1
in cold areas	3
Medium and low pressure piping	
in enclosed areas	1
in cold areas	3
Return mains and branches	
in cold areas	1
Condensate economizers	1½
Hot water tanks	1½
Turbines	2
Kitchen exhaust ducts	2
Steam meters, meter by-pass and meter service traps	3



Lines over roadway have 3-inch insulation.

mains. Steam at 5 to 10 lb is supplied to cast iron radiators and convectors, and also serves as general utility steam. A second high pressure take-off from the east equipment room goes up to the suburban bus level, to supply two Terry steam turbines which drive compressors for the air conditioning units.

To assure ice-free operation, radiant heating coils are imbedded in the elevated portion of the ramp connecting the terminal with the Lincoln Tunnel. The fluid circulated through the coils (Socony-Vacuum's special oil, S/V Soveloid S) is heated to 135 to 175 F by a steam line from the west equipment room.



Steam meter room.

Heated lines and equipment were insulated with 85% Magnesia, a molded product consisting of basic magnesium carbonate, with asbestos fiber incorporated as a binding and reinforcing agent. The work was handled by The Magnesia Asbestos Insulation Co.

Insulation thicknesses were chosen on the basis of type of equipment or lines involved, operating temperatures, and location. In certain areas, termed "cold areas," including the long distance and suburban bus levels, sections of the suburban concourse, and areas around certain stairways and escalators, extra-thick insulation was used on piping.

Piping was insulated with sectional insulation. On all piping other than that located in furred ceilings or spaces, the insulation was finished with a layer of 40-lb rosin-sized paper, followed by on 8-oz canvas jacket sewed in place. For the concealed piping, factory-applied canvas was pasted down and metal bands applied on 18-inch centers.

Flanges, fittings and valves were insulated with 85% Magnesia cement in the same thickness, and finished in the same manner, as the adjacent insulation.

Economizers, hot water tanks, turbines and kitchen exhaust ducts were insulated with blocks, securely wired in place with No. 14-gage soft annealed wire. A layer of 2-inch hexagonal galvanized wire mesh, No. 19 gage, was stretched over the insulation, and anchored in place with tie wires. Except for the turbines, the equipment insulation was finished with a ½-inch thick layer of asbestos cement, applied in two coats. The second coat was mixed with portland cement and troweled to a smooth, hard surface.

The turbines were covered with a carefully fitted, removable metal casing of No. 18-gage black sheet steel.

Flow Characteristics of Air Outlets

Air flow from any outlet conforms generally to laws governing flow from a jet. Results of recent research in England covering air flow from various types of outlets are presented in a paper by A. W. Evans at a Birmingham meeting of The Institution of Heating and Ventilating Engineers recently. Purpose of the paper was to bring out some of the resulting points of good design in a simple manner. Involved theoretical problems connected with air flow from outlets are investigated but the subject is presented from the hard point of view of the practical engineer.

WHEN systems are designed for a fixed rate of air change and maximum and minimum temperatures, quantities of air delivered at specified temperatures are paramount, and methods of distribution are frequently given secondary consideration. Resulting unpleasant drafts may occur, causing unauthorized closure of outlets; or no air movement at all is felt, the atmosphere is stuffy, and windows are opened.

Adequate air movement is an important factor in comfort installations. For a person at rest, velocities of the order of 30 to 40 fpm are required and in warm weather may rise to 63 fpm. Allowances must be made for the cooling effect of air movement which will lower the effective temperature.

Types of Outlets

The various methods of delivery through outlets may be grouped broadly under three headings according to face velocities: (1) low, up to 100 fpm; (2) medium, 250 to 750 fpm; (3) high, 1,000 to 3,000 fpm.

Table 1 shows velocity and outlet requirements for various environments.

Characteristics of a free air jet are shown in Fig. 1. Air at room temperature, discharged directly from the open end of a straight duct, continues on its course for some distance, losing energy in its passage due to friction between still air and moving stream. The drag between moving and stationary air causes entrainment. As the moving air stream builds up by entrainment, it gradually slows down. Any air stream tends to assume a circular cross-section a short distance from the outlet and thereafter follows the same laws as the jet from a circular nozzle. Fig. 1 shows that the true air jet consists of an outer and inner cone. The inner

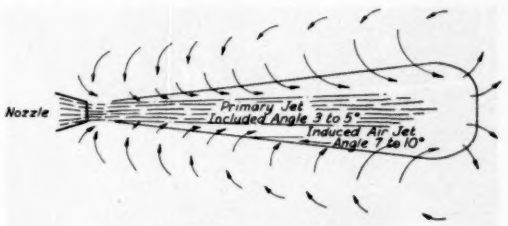


Fig. 1. Characteristics of free jet.

cone of air gradually expands as it leaves the outlet at an average inclusive angle of 3.5 degrees. The outer cone of induced air expands at an average angle of 14 to 19 degrees. The volume of entrainment may amount to 5 or 10 times the original volume of the jet. This is measured as a percentage entrainment per foot and will have a given value for each type of outlet. Outlets causing the jet to have a large surface area have a greater entrainment ratio than a streamlined jet. Thus outlets having high entrainment ratios can provide good air movement with a minimum volume of primary air.

The face velocity of an air stream depends on the pressure difference across the grille face. The equation for air at standard conditions is

$$P = \left(\frac{V}{4{,}005} \right)$$

Where P = pressure difference in inches water gage
V = velocity in feet per minute.

TABLE 1—AIR VELOCITY REQUIREMENTS

Average velocity in working area, fpm	Application	Outlet Type	Outlet velocity, fpm
10-30	Special industrial processes Operating theatres.	Diffusers	40-60
40 variable	Restaurants, hotels, private apartments	Grilles Nozzles Diffusers	250-1,000
40-60	Workshops, offices, theater foyers	Grilles Nozzles	400-1,500
40-100	Assembly and exhibition halls, dance halls, theaters and cinemas	Special grilles and nozzles	700-2,500
200-400	Blast furnaces, foundries, glass works, etc.	Nozzles	1,000-3,000

It is usual to fix a design velocity and obtain the pressure required to produce that velocity. Velocity head is completely dissipated in delivering the air and consequently is an item to be added in the calculation of the system resistance.

The velocity selected is the mean face velocity, and therefore there should be minimum variation across the grille face. Fig. 2 shows typical examples of good and bad design with respect to face velocity. In order to insure even velocity distribution across the outlet there should be:

(1) A good approach duct avoiding bends or change sections within three diameters of the outlet.
(2) No dampers within three diameters of the grille.
(3) If the outlet is larger than the area of the approach duct, then the change section must be very gradual or splitters must be provided.
(4) Where bends must immediately precede an outlet there must be guide vanes.
(5) Static pressure in the duct must maintain the required outlet velocity.

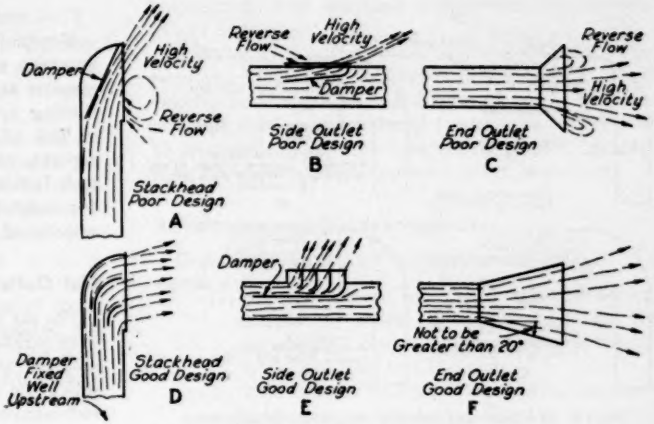


Fig. 2. Examples of good ond poor design.

Direction

The direction of an air stream as it leaves the outlet depends on the resultant of forces due to static and velocity heads of air in the duct. In the case of an outlet in the form of an open duct end, only the velocity pressure acts along the axis of the duct and there is no static pressure at the point of discharge.

In the case of a plenum chamber there is only static pressure and the air flow at any opening is at right angles to the plane of opening.

In the case of a simple opening or orifice in the side of the duct, air will flow out through the opening due to the static pressure within the duct but will have some movement along the duct. The direction from the opening will be at an angle depending on the relation of static to velocity pressure in the duct. The angle of discharge approaches 90 degrees as the ratio of static to velocity pressure increases.

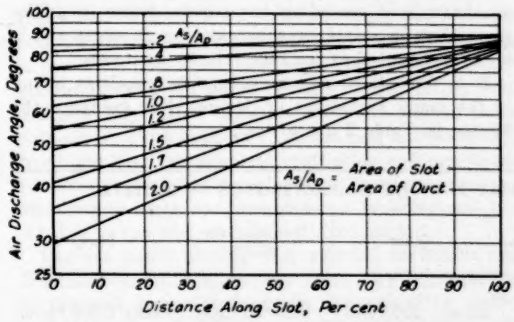


Fig. 3. Angle of discharge, square edge slots. A_s = area of slot; A_D = area of duct.

The actual direction of throw from an outlet is considerably affected by the duct approach to the outlet and the shape and type of outlet. The tendency of a thin walled orifice on the side of the duct to discharge at an angle can be minimized and can be discharged more nearly normal to the direction of the duct by two methods:

(1) Keeping the duct velocity below the outlet velocity, that is static pressure greater than velocity pressure;
(2) By the use of turning vanes.

In the case of a long slot outlet, the pressure vary along the length of the slot and the angle of discharge along the slot also varies. This is influenced by the rate of the area of slot to area of duct. Fig. 3 illustrates the effect on direction of various ratios of slot area to duct area. This diagram can also be used to find the approximate direction in the case of a series of outlets along the duct and is useful in the design of turning vanes for slots or other outlets.

The higher the pressure drop across a grille or outlet, the better will be the control of direction discharged. A combination high pressure with guide vanes or spouts gives complete control. Fig. 4 illustrates the results of tests carried out for various types of outlets on the stack head or vertical riser.

Volume

It is important that actual volumes of discharge be close to the design figures. A tolerance of 5% either way should not be exceeded.

With the design volumes and the number of outlets determined, the design velocity and throw will determine the area of each outlet. Wherever possible, the branch and outlet should be designed to give the correct volume without dampers.

In considering a long duct with a series of outlets, account must be taken of the effect of change in velocity and static head in the duct along its length. Should the duct area be maintained, a reduction in volume at each outlet will result in a corresponding reduction in velocity and increase in static head. This may result in the outlets at the end of the duct dis-

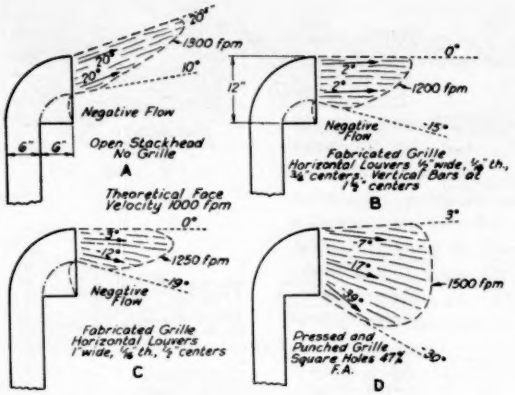


Fig. 4. Direction and velocity diagrams for stackhead outlets. Face, 14 x 12 inches.

charging more air than those at the beginning. On the other hand, if the velocity is maintained constant, the friction may be such that insufficient air will reach the far end of the duct. The static pressure should be calculated at various points on the run and either the duct or outlet areas adjusted to suit.

For good results, the outlet velocity should be at least 20% greater than that of the duct. No dampers would then be necessary, and the balance over a considerable length would be within 5% of the average volume.

Aspect ratio is the ratio of two sides of an outlet:

$$\text{Aspect ratio} = \frac{\text{longer side}}{\text{shorter side}}$$

Outlets having small aspect ratios have a low ratio of perimeter to cross-section area, less skin friction on the jet air, and consequently long blow. Outlets of the slot type have very high aspect ratios, high friction and short blow.

Blow

The distance a free jet penetrates into room air is usually measured arbitrarily as the distance from the outlet to a point where maximum velocity of air stream has dropped to 50 fpm measured along the axis of blow.

The factors determining the length of blow are:

(1) Velocity at outlet,
(2) Area of outlet or the effective diameter.
(3) Residual velocity.

The relationship of these factors is shown in the formula

$$T = K \frac{V_o \sqrt{A}}{V_r}$$

Where

T = throw in feet
V_o = face velocity in feet per minute
A = free area of discharge in square feet
K = constant depending on type and shape of outlet
V_r = residual velocity, feet per minute.

For plain circular nozzles $K = 3.7$. For complete accuracy with other types of outlets, the equivalent circular area should be determined. For average ventilating applications using bar type grilles, calculate on 75% of free area. Examination of various research reports, with close attention to varying methods of test, indicates that the value of 3.7 for K is suitable for outlet velocities up to 2,500 fpm and for residual velocity of 100 fpm.

Slot Outlets

The air jet from a closely arranged source of outlets with parallel flow, irrespective of size or shape, rapidly assumes the conical shape already described after which the flow pattern is as for a single nozzle. For rectangular outlets having low aspect ratios, the effect is that of a circular outlet of the same area. For very long narrow slots a special formula to be used is

$$V_r = 2 V_o \sqrt{\frac{h}{l}}$$

where

V_r = residual velocity, feet per minute
V_o = outlet velocity, feet per minute
h = height of slot, inches
l = length of slot, inches

Two external factors affecting the total throw are:

(1) Temperature, which will deflect the jet either up or down;
(2) In the case of an outlet near a ceiling or wall the jet will tend to slide along the surface, which will offer less resistance than the static air, and the throw will thereby be increased.

Noise

The sound level of an outlet must be selected with regard to the conditions required. Generally, air noise at outlets is not created by the outlet but by a damper or sharp bend preceding the outlet. Noise in grilles themselves is caused by sharp and rough edges and is more pronounced as the face velocity increases.

It is difficult to recommend grille velocities owing to the many variations of design. For guidance the figures in Table 2 are given.

TABLE 2—NOISE CHARACTERISTICS OF OUTLETS.

Type of Outlet	Quiet	Commercially Silent	Noisy
Square mesh or bar grille	Up to 300 f.p.m.	300-750 f.p.m	Above 1,000 f.p.m.
Smooth louvers	Up to 750 f.p.m.	750-1,500 f.p.m.	Above 1,700 f.p.m.
Nozzles	Up to 1,000 f.p.m.	1,000-2,500 f.p.m.	Above 2,500 f.p.m.

Selection of Suitable Types

For a low velocity, low pressure outlet, the duct approach is important and velocity should be gradually reduced in the duct to that of the outlet face velocity. Splitters or guide vanes are advisable.

Low velocity, high pressure outlets require less attention to duct approach because the free area of the outlet is so reduced that the velocity will be 20 to 100% greater than that of the duct. A suitable material for making this type of outlet is standard perforated sheet. Perforations may be from ⅛ to ¼ inch in diameter and may be on up to 3-inch centers to suit the required face velocity. This type of outlet can be used as duct outlets, wall panels, isolated diffusers, or as a perforated ceiling or wall. The large number of tiny jets creates air movement without draft.

Velocities

Included in the low velocity, high pressure outlet is the type consisting of a number of annular rings in the form of cones. Inlet velocity for these diffusers may be 2,000 fpm, which is so reduced that movement is only 100 fpm at the face.

Medium velocity outlets include wire mesh, perforated metal or fancy louver type. Face velocities will be from 250 to 750 fpm. Pressure drop is normally quite small. Duct approach is important and splitters should be used.

High velocity outlets allow smaller air lines to be employed to give an equivalent air movement. High velocity outlets will be in the form of nozzle or spout, although special high velocity louver type outlets may be employed. Where the face velocity is 20% greater than the duct velocity, approach is not important.

Advantages and Disadvantages

Disadvantages of high velocity outlets are:

(1) Noise, which can be reduced by nozzle design, eliminating sharp edges projecting into the air stream. Noise should not cause trouble up to velocities of 2,000 fpm.
(2) Nozzles must be kept at least 18 inches above head level to avoid objectionable air movement.
(3) Care is required in placing the outlets, as a beam on the ceiling or other obstruction can cause a downdraft.

Advantages of the high velocity outlet are:

(1) Reduction of duct sizes;
(2) Elimination of dampers;
(3) Suitability for long or short throw;
(4) Closer control of air.

Engineer Designs Own Working Quarters

When an engineer takes time to become his own client and designs and builds his own working quarters, results are noteworthy. J. Fred Triggs, Pittsburgh professional engineer, said he grew tired of renting conventional office space and decided to build his own headquarters where he could have lots of natural light, quiet, parking space for himself and clients and a functional office layout specifically designed for an engineer's requirements.

Twin Structure

The result is a modern twin structure at 5777-5779 Broad St., Pittsburgh, Pa., which is really two separate buildings connected by a facade to give the appearance of one unit. Both units have large glass areas to admit maximum light and are of one-story construction with concrete floor slabs. Exterior walls are Roman brick with cinder-block back-up. The flat roof has overhangs front and rear for adequate ventilation and provisions for flooding with 3 inches of water for summer cooling. Mr. Triggs owns and occupies one building and the other is owned and occupied by a contractor.

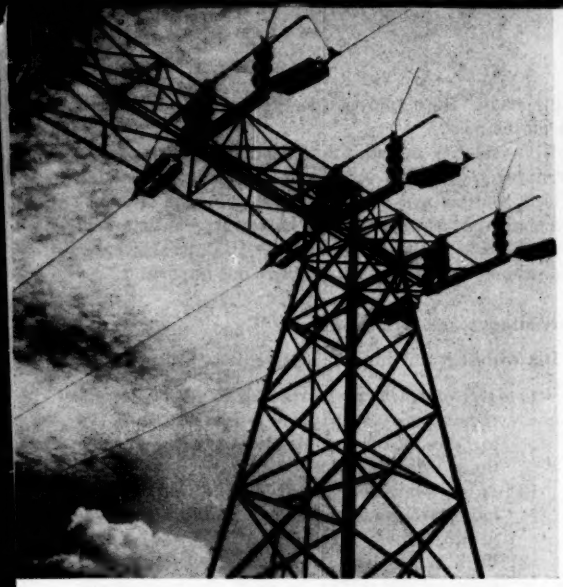
Radiant panel heating was selected to handle the unusual amount of glass area (over 50%) in relation to the wall area, the necessity for providing undisturbed comfort for clients and the engineering staff, and a requisite cleanliness contemplating only casual housekeeping. Complete utilization of floor and wall space is possible, too, through the use of floor panel heating which eliminates space loss that might otherwise result from radiators or registers.

Steel Pipe

The radiant floor panels consist of one-inch butt-welded steel pipe coils spaced twelve inches center to center, pre-fabricated by a local plumbing and heating contractor. The panels were trucked to the job and field-welded in place. An eight-inch layer of air cooled blast-furnace slag was used as a sub-base for the floor, the panels blocked-up two inches above the slag, leveled, and six inches of concrete poured around them.

The separate heating plants are gas-fired boilers with aquastat-controlled pumps. High limit control on boiler heat is 140F and surface temperature of the asphalt tile flooring will be kept to a maximum of 83F. Air temperature of the building is controlled by a thermostat at 70.5F.

This modern office building consists of a spacious reception room, an executive office, large drafting room, a utility cell comprising boiler and utility room, snack bar, and toilet and wash room. Reception room and executive office front on the street, the utility cell occupies the center of the building.



Heating Buildings by Electricity

W. F. FRIEND
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House heating by electric resistance methods, while attractive to many because of its convenience and newness, must compete with heating systems served by relatively low-cost fuels. This 2-part article, a condensation of a paper, Electric House Heating, presented before the Midwest Power Conference in Chicago, covers both the economic and technical phases of the subject. Part 1.

AS of the 1950 year end, nearly 100,000 electrically heated homes are estimated to be connected, with an aggregate power load around ¾ million kilowatts. Electric energy used for house heating last year was something less than 1% of the total residential consumption in this country. Investment by owners for these systems ranges from about $750 minimum for a 5-room dwelling with radiant-convector units, to $3,000 or more for an 8-room house having warm air distributed through ducts. Heat pump installations, which provide both heating and cooling service in year-round operation, involve two to three times the initial outlay ($2,500-$6,000).

Heat Requirements and Electric Loads

Relation of climate and size of house to electric heating requirement is indicated in Table 1. Values tabulated in second column as median for the country are derived from analysis of data on maps plotted to show both degree-days and design temperatures.

Calculated heating-system capacities for residences of two sizes, which between them embrace the range for the large majority of electrically heated dwellings, are also given in Table 1. These sizes are taken, respectively, as five rooms with 8,000 cu ft gross volume and eight rooms with 15,000 cu ft; however, records show a few installations in houses as small as 4,000 cu ft and as large as 30,000 cu ft. Heating capacities are indicated in Btu per hour and in kilowatts installed. Basically, the figures are for houses specially designed to be heated electrically—of tight construction with complete thermal insulation, double windows and no fireplace. Electric heating capacity is usually between 80 and 50% of calculated heat-loss equivalent, this curtailment being an experience factor which gives effect to contribution of heat by other electric service and by miscellaneous sources, and to the adoption of economy practices in utilization of electric heat.

Seasonal electric consumptions for the same two sizes of dwellings appear in Table 2. These represent, again, median values from field data and correspond to a so-called 0.20 "heat factor"; they are for decentralized systems using radiant-convector units and for panel-type installations, individually controlled by thermostat and/or manual switch within each room.

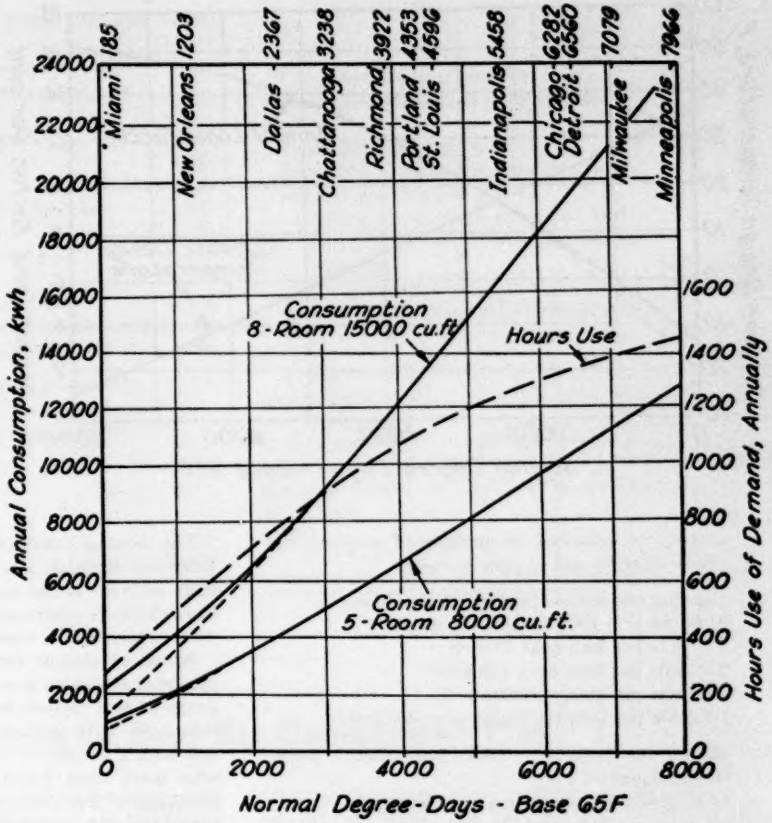
The term "heat-factor," devised in the early 1930's to express electric consumptions for house heating on a unit basis in order to draw comparisons, represents kilowatt-hours within a period, divided by gross volume of heated space in thousands of cubic feet and by degree-days recorded through the same period. Volume is computed from outside measurements, with height taken between bottom of floor joists and top of ceiling joists, or from equivalent dimensions on gross basis.

Annual load factors in Table 2 are derived from measured maximum demand and the recorded annual

TABLE 1—ELECTRIC HOUSE HEATING INSTALLATIONS CAPACITY REQUIREMENTS.

Climate, Degree-Days	Normal Design Temp, F	Calculated Heat Loss, Btu per Hr		Installed Heating Capacity, Kw	
		Gross Volume, Cu Ft		Gross Volume, Cu Ft	
		8,000	15,000	8,000	15,000
0	35	15,500	28,500	4.0	7.5
2,000	20	22,000	40,500	5.5	10.0
4,000	5	28,500	53,000	6.7	12.5
6,000	—10	35,000	65,000	8.2	15.3
8,000	—25	41,500	77,000	10.0	18.0

Data for representative 5- and 8-room houses, built specifically for electric heating; based on analysis of operating records gathered by utility companies. Range of values as reported, for heat loss and installed capacity, about plus or minus 25%.



Power use as related to degree days. Decentralized electric house heating systems used with rooms individually controlled. Data is from representative houses built specifically for electric heating and operated to obtain economy in use of electricity. Heat factor about 0.20 kwh per degree day per 1,000 cu ft gross volume of heated space.

consumption. As can be expected, the load factor for electric house heating is little affected by size of the dwelling. In the Chicago area, it is close to 15%; farther south it drops rapidly, since outdoor temperature used for design does not rise in inverse proportion as the degree-day seasonal heating requirement falls off.

Load and consumption data consolidated in Tables 1 and 2 are averages combining the effects of many variables that influence heating requirement. For houses of construction types giving heat factors either higher or lower than 0.20, the load and consumption may be adjusted in direct proportion to the heat factor. In the case of central furnace type of installation, consumptions are usually 20 to 30% higher; with electric heat pumps, which at present show seasonal performance factor around 2.5, consumptions are reduced to 40% of the quantities tabulated. Values shown for the far South, where degree-day quantity approaches zero, are derived by projection from data applying farther north. More recent figures indicate somewhat greater installed electric heating capacity and energy consumption, raising the annual load factor to something between 3 and 4%.

TABLE 2—ELECTRIC HOUSE HEATING PEAK DEMANDS, CONSUMPTIONS, LOAD FACTORS.

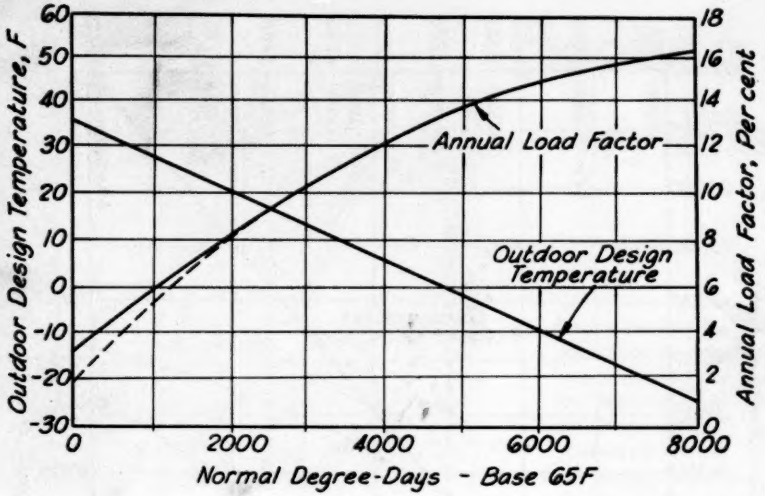
Climate, Degree-Days	Max. Demand, Kw		Seasonal Consump, Kwh		Annual Load Factor, %	
	Gross Volume, Cu Ft		Gross Volume, Cu Ft		Gross Volume, Cu Ft	
	8,000	15,000	8,000	15,000	8,000	15,000
0	3.7	6.8	600	1,100	1.9	1.9
2,000	5.0	9.0	3,500	6,500	8.0	8.2
4,000	6.0	11.2	6,400	12,000	12.1	12.2
6,000	7.4	13.7	9,600	18,000	14.8	15.0
8,000	9.0	16.7	12,800	24,000	16.2	16.4

Data for representative 5- and 8-room houses, built specifically for electric heating; based on analysis of operating records gathered by utility companies. Range of values as reported for demand and consumption, about ± 25%; for load factor, about ± 15%.

Electric Rate Schedules

Studies by individual companies have mentioned the following specimen rates, among others.

(1) Lowest step of regular residence rate, for example, 2¼ cents per kwh; agreement to provide service at that rate for period of a year, with adjustment thereafter



Annual load factor and outdoor design temperature in relation to normal degree days for house with decentralized electric heating systems and individual heating controls in the rooms

as may be indicated by analysis of metered-load characteristics and of service costs.

(2) Regular residential rate which provides
$1.00 first 15 kwh or less, per month
3.5 cents per kwh next 35 kwh
2.5 cents per kwh next 150 kwh*
2.0 cents per kwh next 200 kwh
1.5 cents per kwh for excess over 400 kwh

(3) Rate in territory where cheap hydroelectric power is mentioned—
$4.85 first 300 kwh or less, per month
0.7 cents per kwh next 700 kwh
1.0 cents per kwh for excess over 1,000 kwh

*Plus 200 kwh for each 1 kwh of demand (15-minute) over 5 kw.

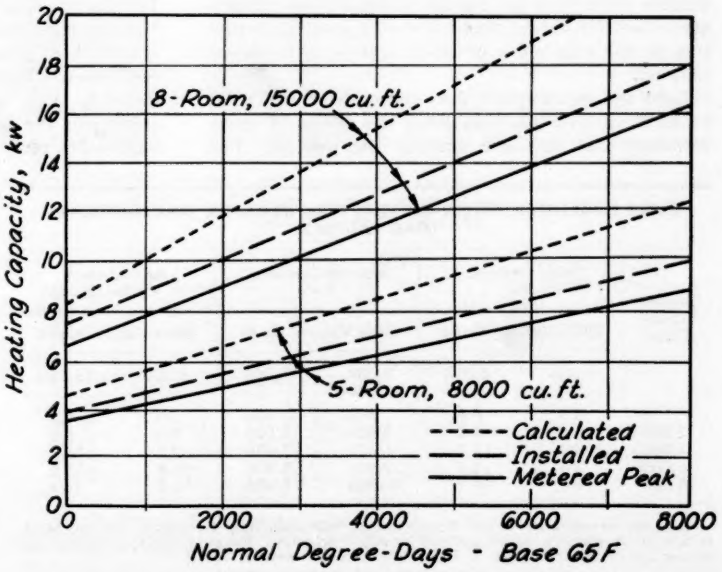
The demand component in case (2), resulting from extension of third block by large increments of load, such as from house heating that bring total demand above 5 kw, is equivalent to $2 per month per kilowatt, where consumption exceeds 400 kwh monthly.

Range of electric costs represented by the several specimen schedules is something over 2-to-1. Since the range of heat factors for houses of differing construction types with various methods for electric heating and with a variety of occupancy requirements is likewise more than 2-to-1, costs of house heating for dwellings of the same size in similar winter climates vary through a range of nearly 5-to-1.

Load Characteristics Observed

Several examples of numerical values obtained, from

Heating capacity for 5-room and 8-room houses with decentralized electric house heating systems and rooms individually controlled.



house-heating studies reported within the past three years, are given below.

Climate: 6,500 degree-days; group of eight 5-room residences, 8,000 cu ft gross, with radiant glass units

Seasonal consumption, average, kwh	10,600
Heat factor, as defined	0.20
Connected heating load, kw	7.6
Maximum demand, non-coincidental, kw	6.6
Coincidence factor*, %	70
Coincidental maximum demand, kw	4.7
Annual load factor, %	
Individual, based on connected load	16
Individual, based on non-coincidental demand	18
Group, based on coincidental demand	25

Climate: 4,300 degree-days, two groups of residences each averaging 10,000 cu ft gross, with (a) radiant-convection unit heaters, and (b) central furnaces.

	(a)	(b)
Number of residences in group	28	21
Seasonal consumption, kwh	13,000	16,800
Heat factor, as defined	0.30	0.38
Connected heating load, kw	15.3	16.4
Maximum demand, non-coincidental, kw	10.9	12.4
Coincidence factor, %	71	77
Coincidental maximum demand, kw	7.7	9.5
Annual load factor, %		
Individual, based on connected load	9.7	11.7
Individual, based on non-coincidental demand	13.7	15.4
Group, based on coincidental demand	19.3	20.1
Coincidental demand at system peak, kw	5.1	6.7
Time of system peak, pm	6:00	6:00

It will be observed that demand load factors in the more severe climate, that is, 6,500 degree-days, are one-third higher than for the milder locality having 4,300 degree-days, in conformity with the trend indicated by Table 2. However, non-coincidental maximum demands exceed the Table 2 "expectable" values by 10 to 15%.

(Part 2 in next issue)

*This factor is the metered combined load divided by the arithmetic sum of two loads when each is metered separately.

Houston Is Best Air Conditioned City

Houston continues to be one of the most completely air-conditioned cities in the nation—if not the first—and, judging by new facilities installed during 1950 and early 1951, will keep in the forefront for some time to come. That is the opinion expressed in the March issue of *Magazine Houston*, which recently completed an air-conditioning survey. The magazine is the official monthly publication of the Houston Chamber of Commerce.

During 1950, it was reported, 19,125.5 tons of air-conditioning equipment were added to the 118,748 operating in Houston, making the total 137,873.5 tons as of the first of 1951. The total does not include some additional 9,300 tons now under construction, mostly in five large buildings.

The number of 1950 installations surpassed those completed in 1949 and added 10% to the previous air-conditioning installed in Houston since the first systems were completed in the city.

"Unless the war makes it impossible to secure the necessary materials needed for the many projects now under way and scheduled, 1951 also will show an increase over 1950," editor Charles E. Gilbert, Jr., pointed out. He added that many manufacturers have ample stocks on hand and that no real pinch would be felt until probably 1952.

More and more Houstonian residents are air-conditioning their homes, the report indicated, with residential installations totaling 7,441 tons during 1950—four times larger than that of 1949, and 2,016 tons greater than in the four years prior to 1949—the previous top year in residential air-conditioning. Residential installations formed the leading item in classification totals.

Department stores in 1950 installed 2,326 tons, just shy of the 2,580 tons which had been installed during all three of the previous years. As a result, few department or apparel stores in Houston are not air-conditioned.

The University of Houston, which is undergoing a multi-million dollar building program, accounted for most of the 2,209.5 tons of air-conditioning installed in educational buildings last year. Food stores ranked fourth in new equipment, installing 1,012 tons, beating the 775.5 tons installed by Houston churches. Since the end of World War II, more than 3,250 tons of air-conditioning equipment have been installed in churches.

Office buildings and individual offices were high up in the order of 1950 cooling installations. Individual offices added 990 tons, and systems installed in office buildings totaled 882. Banks added 500 and hotels, 400 tons.

Other classification totals include: amusement centers, 25 tons; automobile salesrooms, 56; barber and beauty shops, 73.5; candy stores, 5; clubs, 177.5; cocktail lounges, 55; drug stores, 199.5; florists' shops, 31; funeral homes, 30; furniture stores, 112.5; hardware, 120.5; hospitals, 61; industrial, 460; interior decorator, 5; jewelry stores, 13.5; liquor stores, 28; men's stores, 67.5; miscellaneous retail stores, 124; restaurants, 593; theaters, 180; variety stores, 47.5; warehouses, 35; and women's wear, 94.5.

Scrapbook of Exhaust Hood Design

Part 11—Control of Fine Dust Resulting from Mixers

JOHN M. KANE
Chief Engineer, Dust Control Division, American Air Filter Co., Louisville, Ky.

THERE are a few industrial materials which have a toxicity so great that special precautions must be taken to prevent contact, inhalation, or ingestion of even minute quantities of a contaminant released from an industrial operation. Exhaust hooding in such cases must be designed with extreme care, and compromise between hood design and ease of access for the workman can seldom be allowed.

Many AEC (Atomic Energy Commission) operations are in that category and a discussion of exhaust hood features for some of their operations should prove of interest to engineers confronted with design of exhaust hood for maximum possible control.

As would be expected, hoods for such processes will be based on complete enclosures to the fullest degree possible, the use of transparent materials, and automatic remote material handling devices. Metal working machines shown in Fig. 1 demonstrate the extent

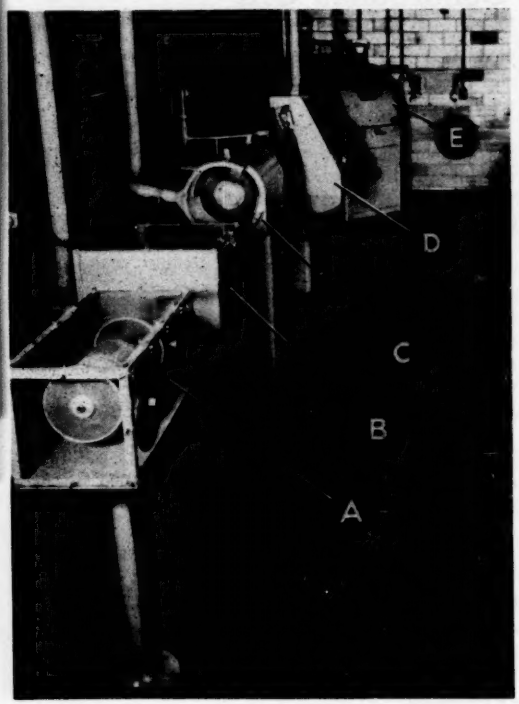


Fig. 1. Where toxicity of the contaminant dictates, usual metal working operations can be enclosed to a degree seldom needed for more customary industrial operations.

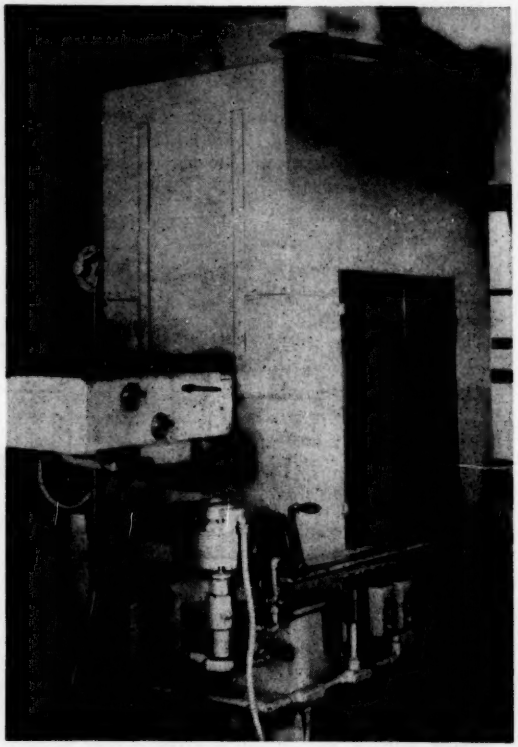


Fig. 2. Local exhaust ventilation is provided to supplement the elaborate enclosure used on this wet cut-off machine.

that enclosures can be provided where conditions dictate the necessity for extreme precautions. The disc grinder *A*, is completely enclosed in a ventilated plexiglass cabinet with removable covers over the 8-inch diameter handholes. Indraft of 500 to 750 fpm would be usual with handhole covers removed, to prevent escapement of material to the room. A similar enclosure completely surrounds the horizontal belt sander *B*, where a single handhole provides the necessary working access. Even the wet, double end, single spindle disc grinder *C*, with its plexiglass enclosures has supplemental exhaust ventilation the equal of a machine tool operated dry. *D* shows the enclosure that can be provided for a vertical belt sander and *E* indicates complete enclosure for worktable operations.

Hoods for machining operations can be developed by the same approach. The cut-off machine, Fig. 2, al-

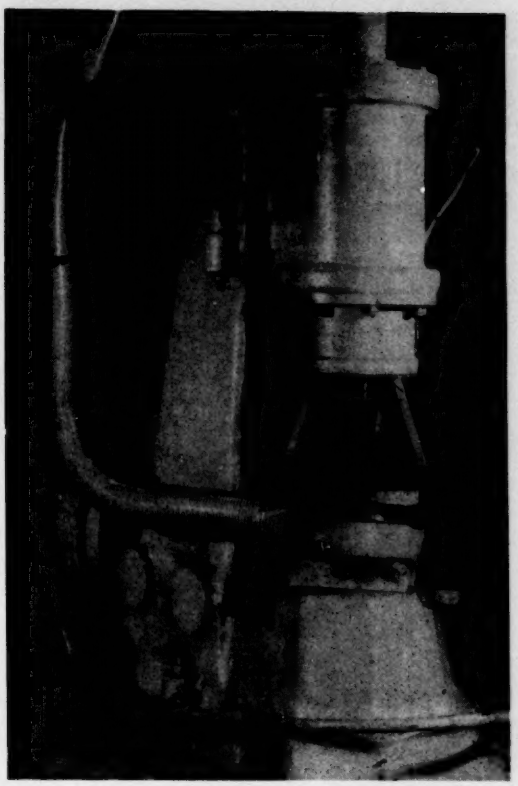


Fig. 3. Annular exhaust ring and plexiglass shield developed for this forging hammer.

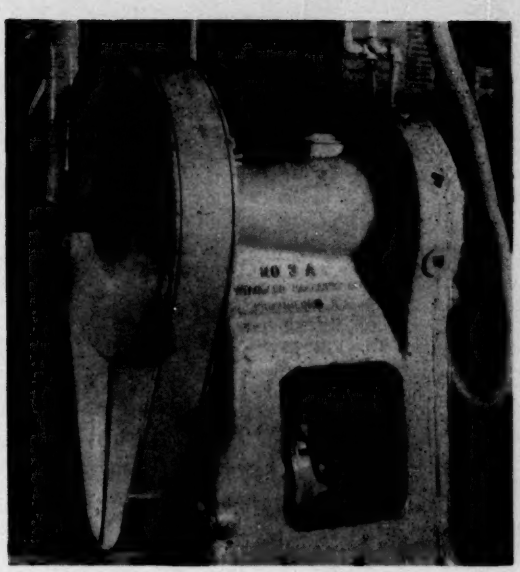


Fig. 5. Rotary swager can be tightly enclosed except cylindrical feed and discharge openings.

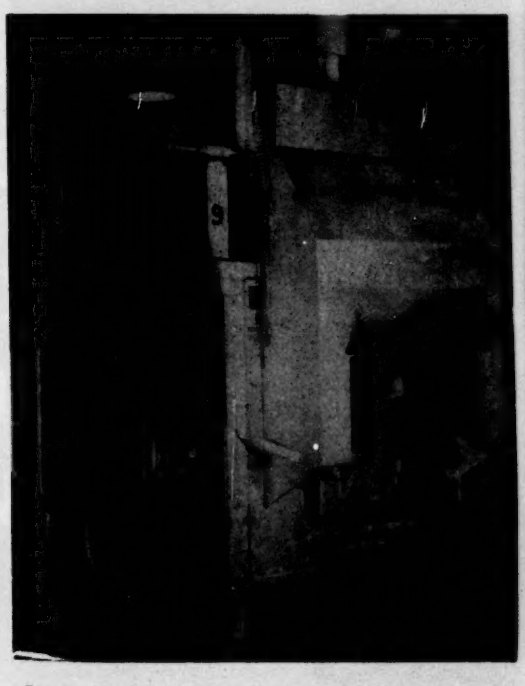


Fig. 6. Hooding in front of this resistance furnace assures removal of any fumes released through the working port.

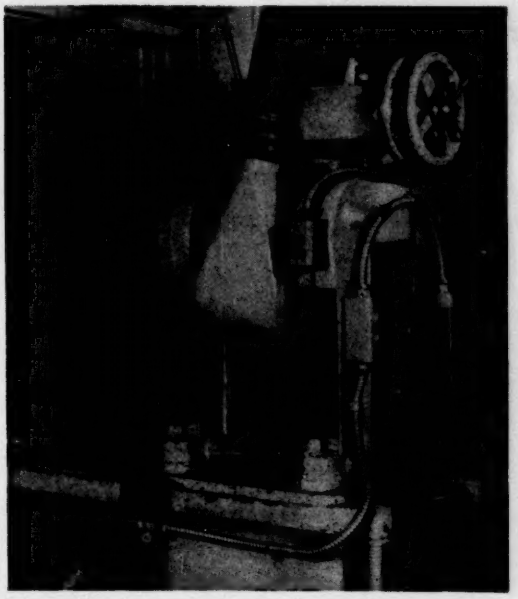


Fig. 4 (left). Exhaust hoods are provided at both feed and discharge ends of this roll mill.

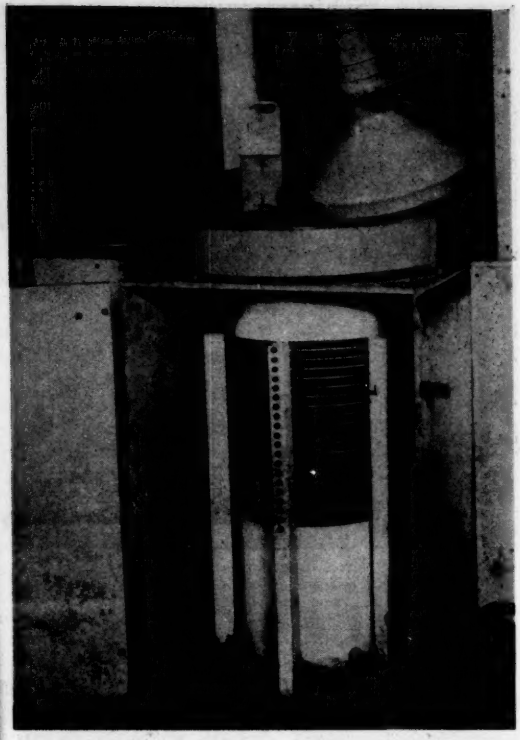


Fig. 7. This vacuum induction furnace can be completely enclosed during the operating cycle, with a movable hood allowing access as required to the top of the furnace.

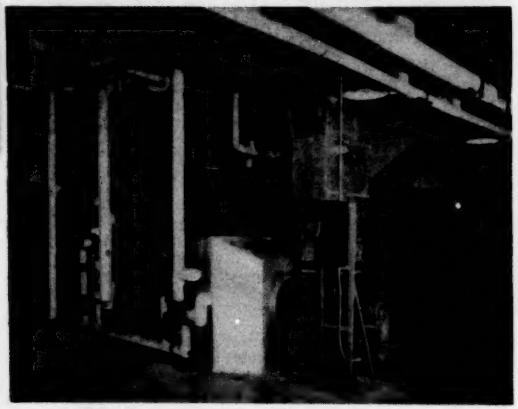
though operated wet, is furnished with 1,600 cfm of exhaust ventilation; the remote operated forging hammer, Fig. 3, has annular exhaust ring and plexiglass shields. Exhaust of 1,000 cfm is sufficient to maintain a 2,000 fpm indraft through the gap between hood and shield. For the 6-inch x 10-inch roll mill, Fig. 4, flexible exhaust ducts and shaped hoods are located close to the feed and the discharge ends of the mill with an exhaust of about 1,000 cfm through each of the two branches. Complete enclosure of the feed and discharge of a rotary swaging machine is indicated in Fig. 5. Exhaust of sufficient air to maintain 1,500 to 2,000 fpm through the cylindrical openings at feed and discharge provides necessary control velocity.

For furnace work, the hood of Fig. 6 provides venting of fumes escaping through the work port. For this 42 kw resistance furnace, specified exhaust volume was 1,000 cfm, sufficient to maintain an indraft of 350 fpm, through the opening in bottom of hood and through the working opening covered whenever possible with the hinged cover. The 12-inch vacuum induction melting furnace, Fig. 7, was completely enclosed with an annular hood exhausting the feed opening. After charging, the conical hood with flexible duct connection covers the feed opening to provide the most complete enclosure possible during the melting cycle.

Acknowledgment

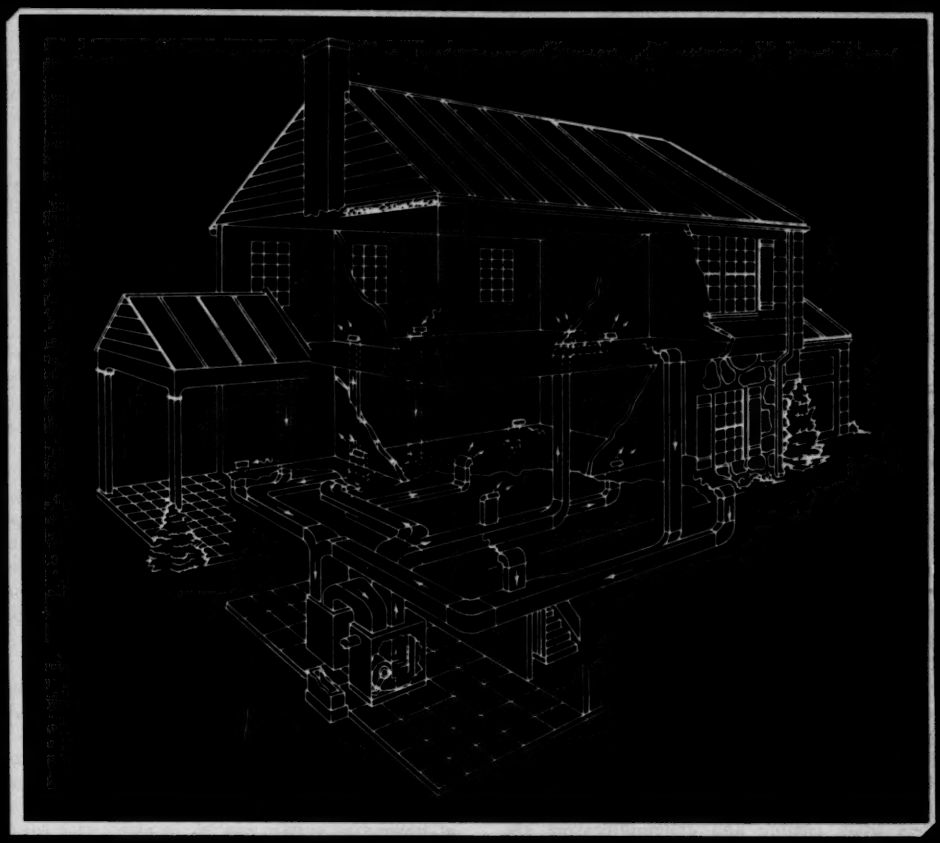
Data presented in this review are based on material prepared by W. H. Baumann, Oak Ridge National Laboratory, for the American Industrial Hygiene Association.

Equipment in Buildings of Argonne National Laboratory



Ventilating equipment for the new Physics and Metallurgy "Hot" Laboratory Building of the Argonne National Laboratory is installed in the basement under the cave room. Equipment is operated by remote control. Laboratory buildings were constructed by The Austin Co.

Installing stainless steel ducts to serve the laboratory hoods in the Chemistry Building, Argonne National Laboratory. Partitions divide each of the six wings of the building into a number of individual laboratories. On floor are service strips to be set above laboratory benches.



YEAR-ROUND AIR CONDITIONING FOR RESIDENCES

by G. R. WACHTER and C. M. GERHART – York Corp., York, Pa.

Year-Round Air Conditioning for Residences

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Covered in this practical article are methods of combining air conditioning for summer cooling with heating for the winter months to provide year-round air conditioning for residences. Various systems are described and valuable design data presented. Article is largely devoted to summer air conditioning linked with seasonal delivery of warm air.

THERE are many ways to cool or summer air condition a residence. The most common approach is through the use of window or console type of room conditioners for low cost cooling of a single room. In multiples of two or more units they have been successfully used to condition small homes or complete floors of large residences.

Generally for the summer cooling of entire residences, custom designed systems are installed which utilize commercial type packaged or self-contained units. For the larger residence, the 3 or 5 hp packaged unit is used as the core of a central air conditioning system. While it provides satisfactory service for the periods when cooling and dehumidification are required, for winter comfort it is necessary to have a separate heating system or provisions for supplying warm air so that one system of ducts can be used throughout the year.

This article is largely devoted to design data covering summer air conditioning linked with the seasonal delivery of warm air to provide year-round air conditioning for residences. Year-round air conditioning for such houses may be supplied by one of the following.

(1) Heating and cooling systems entirely separate.

(2) Heating and cooling linked by a common distribution system and circulating fan. There can be deviations of this arrangement by placing the fan in the summer air conditioner, in the furnace, or by having the fan separate from the heating and cooling unit.

(3) Heating and cooling linked by a common distribution system only.

Heating and Cooling Entirely Separate

Permanent installations of window or console conditioners with heating provided by an independent means, such as standing radiation or unit heaters, come under this classification. They are largely limited to existing homes where it is desired to avoid extensive building alterations. However, they have been successfully used in dwelling units of large new apartment developments. In the rambling ranch style home, this arrangement may afford a means of simplifying installation and reducing costs below that of a central system that would require unusually long duct runs. Where space in the conditioned area is not available, or where for other reasons it is not desirable to use window or console units, the cooling components can often be located in closets or attics. The water-cooled console types are light enough to be safely supported by most attic construction. If there is doubt, the unit should be located over a partition wall for added support. Where headroom is low, it may be of advantage to use a refrigerant circuit and a separate fan unit alongside to reduce the equipment height.

This refrigeration circuit is a factory sealed refrigeration unit consisting of a capillary fed evaporative coil, hermetic compressor with necessary controls, and water-cooled condenser.

In many places in southern latitudes where gravity floor furnaces and attic fans are in general use, the attic fan can be supplanted by an air conditioner and a simple duct system run in the attic, with the return grille located in the ceiling. The space required for a large attic fan is ample to house a console type conditioner. In mild winter climates where this type of installation would be applicable, the existing unit heating system is usually satisfactory and no change need be made. In locating conditioners in attics, special precautions should be taken to insure that the condensate drain cannot clog easily and cause an overflow that may damage ceilings.

Where separate cooling and heating systems are used, there is no problem of readjusting the air quantities when changing from summer to winter operation and vice versa. Once each system has been balanced for the desired amount of air to the spaces served, no further adjustment is necessary. Heating or cooling is readily available by turning on the appropriate system. This is a distinct advantage in climates where sudden or unseasonal temperature changes are experienced. The separate cooling system may also be favored where it is desired to provide cooling for a portion of the home, where space limitations at the furnace location prevent tying-in to the central systems, or where heating outlet grille locations may be considered unsuitable for summer air conditioning duty. Multiple installations of unitary apparatus always have the advantage of increased flexibility and

economy of operation over the central system. The main disadvantage is having the equipment spread around the home, often in places not easily accessible.

Common Distribution System – Fan in Summer Air Conditioner

This arrangement of heating and cooling units linked by a common distribution system and circulating fan, with fan in summer air conditioner, is most extensively used in southern latitudes in new construction. Due to the mild winter climate, light duty accessory equipment can be successfully used in conjunction with a summer air conditioner. The accessories may take the form of a heating coil within the air conditioner or a gas-fired duct heater externally connected. This arrangement may be used in colder climates where the source of steam or hot water for the heating coil also serves supplementary standing radiators or heating panels. This is commonly known as a split system.

If it is necessary to provide a boiler to furnish hot water or steam for the heating coil, the first cost of equipment will be high and such a system would be considered a deluxe job. The use of the duct heater is less expensive but may not be possible in some localities where codes closely regulate their application.

When the heater is in the supply duct, many codes and accepted practice require a by-pass arrangement around the heater for summer operation. This provides a passage for the cold air from the air conditioner to the supply ducts. Otherwise the conditioned air must pass through the heater where it could cause harmful condensation inside the heat exchanger tubes and combustion chamber. The condensation, more pronounced in extremely damp climates, is the result of vapor travel down the flue due to the difference in vapor pressure between the outside air and air at the cold surface of the heat exchanger. There is concern that the moisture will cause early deterioration of the heat exchanger, especially in the popular lightweight sheet metal type, to the extent of permitting flames and fumes to enter the air stream. The hazard is not nearly as great with the cast iron, laminated nonferrous metal or stainless steel types. It is certainly safe practice to provide a by-pass, although it does complicate the duct installation in residences where space is usually at a premium anyway. It also decreases the flexibility in converting from summer to winter operation.

The design of 3 and 5 hp central conditioners with hermetically sealed refrigerant circuits offers one solution to this problem. Space permitting, the heater may be placed in the return air duct where the warmer return air passing through it is not as likely to produce condensation within the heat exchanger. In conventional refrigeration systems, the objection to this arrangement is that hot air from the furnace passing through the cooling coil can produce excessive pressures causing valve and seal leaks and constituting a hazard unless the refrigerant charge is entirely pumped into the receiver and closed off by valves. However, the sealed system minimizes the difficulties of refrigerant leaks and the small refrigerant charge used in the system, as compared to the internal volume of the system, prevents excessive pressures within the range of discharge temperatures experienced with a direct-fired heater. At a relatively low temperature, the entire refrigerant charge of the system is evaporated and only refrigerant vapor exists.

In the past, it was somewhat of an inflexible rule that direct-fired heat exchangers be located in a forced air system so that a positive pressure be maintained on the outside of the heat exchanger. Where direct-fired furnaces are used and the type of fuel is not specified, this method of installation constitutes safe practice to prevent pulling poisonous products of combustion into the air stream. However, where natural gas is used for fuel, the products of combustion are harmless providing sufficient combustion air is used. In view of this, it is considered safe practice to place the natural gas-fired duct heater in the return air duct on the suction side of the fan. It may even be argued that the return duct location is preferred since it does not permit air to be forced into the combustion chamber in the event of a leak. Forcing air into the combustion chamber may be hazardous by interfering with combustion and causing carbon monoxide to be formed and forced out of the heater into living areas.

Duct heaters offer tremendous possibilities for compact and economical installations in conjunction with air conditioners. However, since they are relatively new in residential work, care should be exercised in their application to conform to manufacturers' recommendations and local codes that may apply.

There is one uneconomical operating feature peculiar to systems using the air conditioner fan for both heating and cooling. The operating cost for the fan motor during the heating season will necessarily be higher than it would be for a furnace used only for heating. The higher operating cost is due to the greater horsepower required to overcome the air pressure drop of not only the heating coil or furnace and ducts but also to the cooling coil through which the fan must continually pull the air.

Fig. 1 illustrates how a gas-fired duct heater is used in conjunction with a 3 hp central air conditioner. The heater was placed in the return air duct to reduce the possibility of damage by sweating and to eliminate the need for a by-pass. In this particular design, it was necessary, in order to obtain the required cross-section area within the space limits, to split the return so that one runs under the closet door and floor and one runs above the closet door.

Common Distribution System – Fan in Furnace

In the colder northern climates where winter heating is the primary consideration, the simplest and most economical means of achieving year-round air conditioning is to use the furnace fan of a direct-fired furnace to circulate air for both heating and cooling. Due to the more severe heating requirements, furnaces are likely to be constructed for heavier duty and have the reserve fan capacity usually needed for cooling duty. The cover illustration shows a typical home in the northern or eastern section of the country with the forced warm air heating system modified for year-

round air conditioning by use of a furnace type summer conditioner. Refrigerant circuit sizes 1½, 2, 3 or 5 hp are also applicable to this arrangement.

For summer operation, the furnace fan must be speeded up to overcome the additional pressure drop in the air system introduced by the cooling coil and to maintain the same or greater air delivery to the duct system as in winter. The same total air quantity can be used for heating as well as cooling as long as it is not necessary to heat the air above 135F to carry the heating load. In some cases it may be necessary to speed the fan sufficiently to obtain more air delivery for summer than winter operation. The practical limitation here will be governed by the amount of fan noise that can be tolerated. Before attempting to add summer air conditioning to a forced warm air furnace, the furnace fan should be carefully inspected to determine if the fan construction is sufficiently rugged to handle the additional static pressure requirements.

Where only certain zones of the house are to be cooled at any one time, somewhat less total air quantity will be required for cooling than for heating. In such cases the mere addition of the cooling coil alone to the system may reduce the fan delivery the required amount without adjustments to fan speed. The higher air delivery necessary for heating can be restored by providing an air by-pass around the cooling coil that can be readily controlled by the owner. Such a by-pass may be an integral part of the furnace type conditioner.

Where the heating season is long, it is advisable to provide means for by-passing the cooling coil and reducing fan speed for quiet as well as economical operation. During winter use, the fan cycles on and off making fan noise more noticeable. The least expensive means for accomplishing these changes is by manually changing the damper or dampers and fan motor drive pulley.

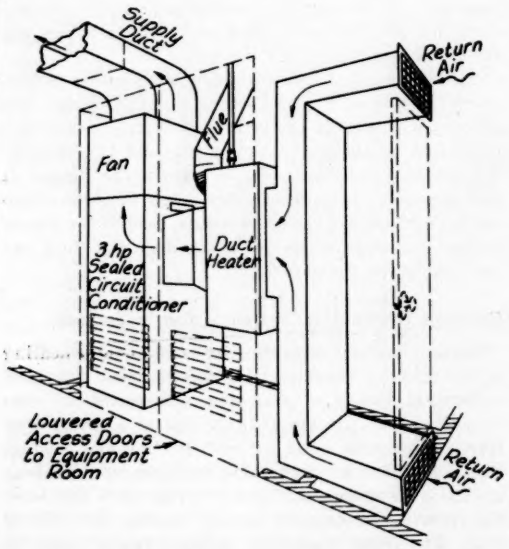

Fig. 1. Gas-fired duct heater used in conjunction with a 3 hp central air conditioner.

However, electrical devices such as 2-speed fan motor or variable speed fan drives and damper motors could be used to accomplish the change by remote control.

The previous discussion on condensation in duct furnaces will also apply where the cooling units are placed in the furnace return air duct. Often, it is more convenient in existing basement installation to connect the cooling unit into the return air side which is usually reduced to one large, low velocity duct where it reaches the furnace. The supply may consist of many ducts branching off directly from the furnace bonnet and be more difficult to break into. If it is felt the condensation problems are serious enough to warrant it, the cooling unit may be connected to the discharge side of the furnace. However, to minimize velocity losses, the air velocity in the connection between the furnace discharge and cooling coil should not exceed the velocity through the coil.

Several types of direct-fired gas furnaces are now on the market, designed for attic installations. The compactness and lightness of sealed refrigerant circuits make them ideally suited for use in conjunction with this equipment to provide year-round air conditioning for basementless homes.

Another type of standard equipment on the market that can be used in conjunction with refrigerant circuits to provide year-round air conditioning is an air unit heater containing a fan and heating coil.

Common Distribution System with Fan Separate

In some cases it may be desirable to use a fan separate from both cooling and heating components to meet special space requirements. This arrangement consists of a duct furnace, refrigerant circuit, and a field-built or packaged fan section. A typical apartment application of this type is illustrated in Fig. 2. The compact arrangement makes it possible to fit a complete year-round air conditioning system into a small closet space in the kitchen. It is necessary to reposition a damper to convert from summer to winter operation but this is not a serious drawback in this case since the equipment is readily accessible.

The proper air quantity should be provided through duct heaters as well as the refrigerant circuits to obtain satisfactory operation. Manufacturer's recommendation should be used, but two useful rules of thumb are: 11 cfm per 1,000 Btu per hr of output capacity for direct-fired heaters and 450 cfm per hp capacity of refrigerant circuits.

Common Distribution System Only

A system using a complete summer air conditioner with its own fan, and complete forced warm air furnace with its own fan, both discharging into a common distribution duct system, is more expensive but it eliminates many of the problems attendant to systems using a common fan. However, it is still necessary to use a damper arrangement, at least in the discharge side, to prevent air from the unit in operation from by-passing through the unit not operating. Otherwise, the conversion from summer to winter operation can

be made quite simply without need for fan adjustments, regardless of the difference necessary in winter and summer air requirements. The possibility of condensation in the furnace during summer operation is also eliminated, since the cold discharge air from the

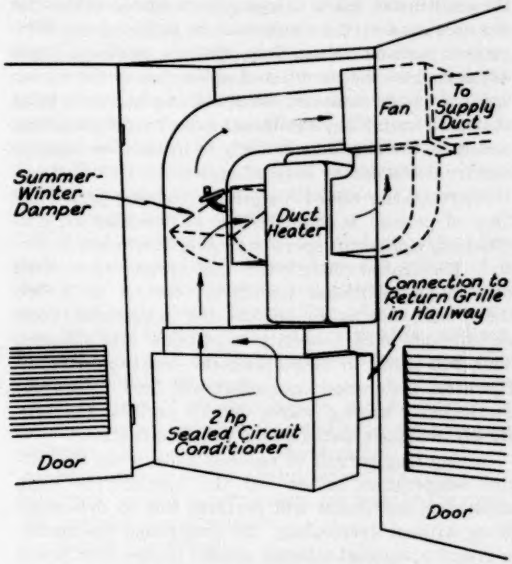

Fig. 2. Arrangement of a furnace, refrigerant circuit, and a packaged fan section. Unit can fit into a small closet.

air conditioner does not pass through the furnace. This type of system is often desirable for application in mild winter climates where light duty furnaces with small fans are used which may be more susceptible to condensation damage and may not have reserve fan capacity for forcing air through a cooling coil.

Fig. 3 illustrates an actual installation using this type of arrangement with a 2 hp console type air conditioner used as a central system conditioner by the addition of discharge air and return air connections. The furnace and air conditioner both discharge into a common supply plenum in the hallway. Dampers are provided to prevent by-passing air through unit not in operation. A damper is also provided in the supply plenum so that all air can be diverted either to bedrooms or living areas. By leaving the damper in the center position, air can be supplied to the entire house. The crawl space under the floor of the house is used as a return air plenum. A short length of return duct connects the inlet of the air conditioner to this plenum. The furnace is a bottom inlet type, receiving its return air through a hole in the floor over which it is placed.

Estimating Loads

Since detailed instructions for making load estimates for residences could comprise an article in itself, this section is limited to a discussion of the distinctive characteristics of the residential cooling load. Existing data and load calculation forms are readily available for use in residential applications. Often, however, the determination of the required cooling capacities can be somewhat simplified from commercial practice.

The typical residence will have a small internal load due to people, lights and appliances. The major load is from highly variable external sources, such as the heat of the sun shining on exposed walls, roof and glass, and the outside air temperature.

This is in direct contrast to most commercial applications which have high internal loads that make the variable external loads small by comparison. It has become common practice in estimating commercial loads of this type to take the external loads at their maximum value since their relative magnitude does not materially affect the final result.

This practice, however, when carried into residential applications may result in a greatly overestimated calculation based on a maximum instantaneous load instead of an average requirement. The thermal storage capacity of a house and its furnishings has a tendency to flatten out or average the load peaks. A peak load of short duration may not be evidenced immediately in a rise in inside air temperature but will be absorbed by the building mass. This is sometimes referred to as "heat flywheel effect" and reduces the maximum capacity requirements of the equipment considerably below what would be indicated by instantaneous peak values of the external loads.

Experienced designers make allowances for thermal effect when calculating residential cooling loads. They may apply a factor to reduce the calculated maximum load as much as 25% in massively built houses. Frame houses will, of course, have less thermal capacity than those constructed of solid masonry. Other variables also affect the use of a thermal capacity factor,—geographical location, duration of peak load and severity in relation to average load and hours of use.

Some authorities suggest that latent loads can be omitted from residential load estimates, thereby simplifying the necessary calculations. This approach is based on the practical assumption that due to the low ratio of latent load to sensible load, any equipment

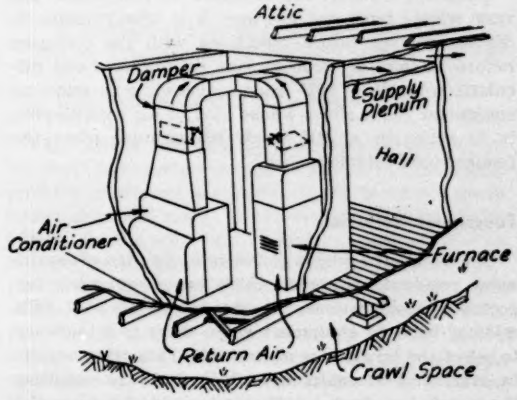

Fig. 3. Equipment arrangement for a single-story house with attic. System is served by two separate units and a common duct system.

selected to handle the sensible will also handle the latent. Except in unusual cases where the designer is required to make special allowances for high people-concentrations or appliance loads, the latent load calculations can be safely ignored. In the average home, the number of occupants per square foot is low. Ventilation requirements are low and usually one air change per hour is sufficient.

A lighting load is not ordinarily figured if sun effects are included in the load.

Where a performance guarantee is made, the kitchen area is excluded since the appliances could conceivably put as much load on the conditioner as all the rest of the house combined. Special treatment should be given to heat-generating appliances to remove the heat at the source. Exhaust hoods are advisable above ranges.

Efforts to reduce external heat loads due to exposure will be rewarded in reduced equipment size and operating cost. Awnings, outside venetian blinds, reflective screening, overhanging eaves, double glass, insulated ceilings or walls, ventilated attics and roof sprays are some of the means used to reduce residential heat loads.

The commonly accepted inside design condition of 80F dry bulb temperature may be too high in some cases for ideal conditions in the average residence. When occupancy time is long, contact is lost with outside conditions and a somewhat lower temperature is demanded for comfort. Experience has shown that, equipment capacity permitting, most people will attempt to hold a temperature around 76F in their home.

Nevertheless, on installations where economy is a prime consideration, 80F should be used for an inside design temperature. During periods of low load the conditioner can be permitted to pull the entire house temperature down below 80F. When the load rises to a maximum, usually in the late afternoon, the load in excess of the capacity of the conditioner will be absorbed by a temperature rise in the house. Ordinarily this slip in temperature will not be objectionable, since the conditioner running continuously will do a good job of reducing the humidity. The effect of the lowered relative humidity will be to offset discomfort as a result of the higher dry bulb temperature.

Since the comfort requirements of individuals can vary widely from the average, it is wise practice to discuss desired inside conditions with the customer before attempting detailed load estimates. Load calculations based on 80F will be misleading in selecting equipment for a client whose idea of air conditioning is to maintain a 72F inside temperature when the temperature outside is 95F.

Equipment Selection

The calculated load will indicate the size of equipment required. However, there are often other important considerations. If the calculated load falls midway between equipment sizes, there is a tendency to select the larger size equipment. This often results in oversizing of equipment which not only penalizes the installation from a cost standpoint but hinders the conditioner from performing well in keeping the humidity down due to frequent off cycles.

As a refrigerated cooling coil removes moisture by condensing it out of the air as it passes over the coil surfaces, this dehumidification stops soon after the compressor has been cut off by the room thermostat. The thermal effect of the cool mass of the house and furnishings tends to retard a rise in temperature in the conditioned space, delaying for a considerable time the operation of the thermostat in bringing the compressor back on. Meanwhile, there is continual vapor diffusion into the conditioned space due to the higher vapor pressure outdoors. With nothing in the building structure having any significant capacity for absorbing moisture, the humidity is likely to increase to unsatisfactory levels during long off cycles.

Short cycling (short compressor running period and long off period) is characteristic of oversized air conditioning equipment operating under thermostatic control. Residential conditioners that are oversized often require an additional humidistat control or a low thermostat setting to prevent the compressor from cutting off until humidity conditions are satisfied. This will result in overcooling the conditioned space. However, undersized equipment will tend to operate continuously during warm, humid periods and constantly maintain satisfactory dehumidification.

During long periods of reduced loads, when the outside temperature is low but the humidity is high, undersized equipment will perform well in dehumidifying without overcooling. By undersized equipment, is meant equipment selected smaller in size than would be indicated by a conventional, maximum instantaneous load calculation.

Installations with undersized equipment are usually a result of trying to economize on first cost or operating cost. It is not recommended where exact conditions must be guaranteed unless an accurate comparison can be made with an existing similar installation where performance is known. These installations are often put in with the understanding that the equipment will only cool a portion of the house at a time. In many cases very gratifying results have been obtained, in that most of the time the conditioner will cool the entire house. The installations shown in Fig. 2 and 3 are examples of this.

The 3 hp conditioner for the installation in Fig. 1 was selected mainly for the convenience of the ample sized heating coil and other features of the conditioner. However, during summer operation the compressor was found to run only 50% of the time while maintaining 78F room temperatures. From a cooling load standpoint, a 2 hp conditioner could have adequately handled the load.

As a result of analyzing operation of satisfactory residential installations, an average figure of 600 sq ft per compressor horsepower has been arrived at as amply safe for residential work in making rough checks on calculations and even in estimating equipment size where guarantees are not required. This figure applies where outside design conditions are between 95F and 100F, the house is of good construction with insulated ceiling, and there are no heavy loads due to unusually large glass exposures.

If the system fails to deliver the apportioned amount

of air, which is the heat conveying or absorbing medium, from the central apparatus to each room in the amount required to match the load, unsatisfactory temperatures will result. It is obvious then that an air conditioning installation can be no better than the air distribution system standing between the central apparatus and the living spaces which it serves.

The design of an air distribution system to serve the dual purpose of heating in winter and cooling in summer becomes more difficult in residential work than in other applications. There are problems of (1) keeping within limited space requirements, (2) providing for seasonal balancing, (3) providing flexibility of operation without sacrificing simplicity of control, (4) keeping the total price of the installation reasonable with respect to the cost of the house.

It is not uncommon to find air temperature variations as great as 15F between floor and ceiling of a room in which air motion and air distribution are not positively controlled. The settling of the cooler air near the floor level is known as stratification, and can be prevented only by proper air movement and distribution within the room.

The problem of air distribution and air motion is not complicated providing the following vital factors are given a fair amount of consideration:

(1) Temperature of the air introduced into the room.
(2) Total number of air changes per hour in the room.
(3) Register characteristics.
(4) Register locations.

Temperature of Entering Air

The temperature of the air introduced into a conditioned area is dependent upon the capacity of the conditioner to heat a given quantity of air to a predetermined temperature during the winter season or its capacity to cool a certain quantity of air during the summer season. The amount of air to be cooled or heated is determined by the internal sensible heat gain for cooling and the internal sensible heat loss for heating, as well as the difference in temperature between the design room temperature and the air leaving the register.

$$CFM = \frac{H}{1.06\ (T_d - T_r)} \text{ for cooling}$$

$$CFM = \frac{H}{1.08\ (T_r - T_d)} \text{ for heating}$$

where

CFM = Total quantity of air (cubic feet per minute) to be circulated within the conditioned area.
T_d = Design temperature, F, of conditioned area for summer conditioning or return grille temperature for winter conditioning.
T_r = Temperature, F, of air leaving register.
H = Internal sensible heat gain for cooling, and internal sensible heat loss for heating (Btu per hour).

During summer operation, air enters the conditioned space at a temperature usually 12 to 18F less than the design room temperature, while winter operation utilizes conditioned air temperatures of 65 to 75F above the design room temperature. The large variations in temperature between room air and register discharge air during the winter operation cause the air to diffuse throughout the room. Warm air has a tendency to rise to the ceiling and therefore a strata of cold air occurs near the floor level if proper distribution and air motion are not obtained. On the other hand, the cool air leaving the register, during summer operation, has a tendency to fall and to produce a strata of cold air near the floor level, similar to winter operation. However, stratification during summer conditioning is not near as noticeable nor as harmful to human comfort as winter stratification.

If low register temperatures are used during summer operation or high discharge temperatures during the winter season, the cfm required for circulation will be small and the problem of air motion and distribution will become very intricate. This condition usually results in an unequal temperature distribution throughout the room and a feeling of discomfort to the occupants.

Air Changes in Room

Previous discussion emphasized the necessity of maintaining a certain differential between the register and design room air temperatures so that the number of cfm introduced into the conditioned area was not too small to allow an accurate regulation of air motion and temperature distribution. However, uniformity of air motion and temperature distribution are also dependent upon the relation of total air circulation to the volume of the conditioned space.

The total number of times that the volume of air in the room can be changed in one hour by the volume of air issuing from the register is known as the total number of air changes per hour. The total air changes for any installation may be figured as follows:

$$N = \frac{60 \times CFM}{C}$$

where

N = Total number of air changes per hour.
CFM = Total air discharged into room (cubic feet per minute) through register.
C = Total volume of room (cubic feet).

Applications having a small number of supply outlets and a low number of total room air changes usually produce insufficient air motion in parts of the conditioned area and result in uneven temperature distribution. On the other hand, a large number of total air changes usually produces too much air movement and results in a feeling of discomfort due to drafts. The effects of an excess number, or of an inadequate number, of air changes may be overcome only by careful regulation of the number, location and type of supply openings and the discharge velocities of the air leaving the register face.

It is not possible to recommend the definite number of air changes necessary for any application, since this

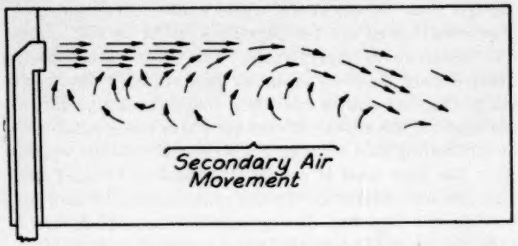

Fig. 4. Path of secondary air movement within a room.

factor will depend upon the particular conditions under consideration.

Register Characteristics

In the selection of any register, it is necessary to compare its operating characteristics with the requirements of the particular application. It is essential to analyze each air conditioning application to select the proper register and insure correct air distribution. For instance, an installation may require that the conditioned air from the register move forward for a long distance in a horizontal direction without any consideration for movement to the right or left (deflection) of the register; or, it may be necessary to eject the air into the room in a fan-shaped effect so that air motion is insured at the right and left of the register but very little movement is produced in a forward horizontal direction. Since it is important to select registers according to their operating characteristics, it is essential to have a fair knowledge of some of the factors which influence their choice.

The air leaving the face of a register contains a certain amount of energy which is dependent upon its quantity and velocity. It is obvious that after an air stream leaves the register face, it is no longer propelled by the fan but must rely upon its own stored-up energy to produce its forward motion. As the air stream moves along its path, it imparts its energy to the room air and sets up a secondary air movement within the room similar to that shown in Fig. 4.

The amount of room air set in motion will depend upon the perimeter and velocity of the air jet leaving the register face. With high velocities of air flow from the register, the amount of secondary air movement may be very noticeable. As the energy of the air from the register is transferred to the room air, the air stream velocity gradually reduces and finally becomes imperceptible. The distance that the air stream will travel from a register in a horizontal plane (throw) is dependent upon both its volume and its velocity. For a given volume of air displacement, the throw of a register has a definite relationship to the face velocity. It must be remembered, however, that the shape of the air stream leaving a register will depend upon the design of the particular register. Therefore, when selecting registers, actual operating characteristics data should be obtained from the manufacturer.

The straight flow type of register is used on all installations which require the air to be thrown a great distance in a horizontal direction. The face velocity of the straight flow register is usually high and the size of the register can be relatively small. There are certain applications, however, that require a high cfm and a very short throw in order to prevent the air from rebounding off the opposite wall and causing a drafty condition. To reduce the throw of the straight flow register, it is necessary to decrease the face velocity, but this procedure requires an increased register size in order to produce the specified cfm.

Since the straight flow register has definite limitations in the control of its throw and spread, a method of increasing the face velocity without a consequent increase in throw has been devised. Tests have proved that the deflection of the bars of the register face cause the air to move into the room in a fan-shaped pattern and force it to come into contact with an increasing amount of room air. Registers having their bars deflected to either right or left transfer their energy more quickly to the room air and, therefore, have a shorter throw.

The resistance to air flow of the non-deflected registers is less than one-half of the two-way deflecting type, while the throw of the former type is approximately double the throw of the deflecting register. If the cfm and the throw are fixed by the space to be conditioned, then, as the horizontal deflection is increased, the register face velocity is increased and the size of the register may be reduced. Hence, by varying the horizontal deflection of the air stream, it is possible to maintain a relatively high face velocity and still confine the throw to the space allowed, thereby reducing the register size.

Deflection settings, which deliver the air stream in a direction essentially at right angles to the register, have been discussed as a means to shorten the throw. However, they are often utilized to promote proper distribution within the conditioned space, since a larger area is being blanketed. It is often necessary to deflect the whole air stream to the right or left for the purpose of distribution. When the register outlet is located in the corner of a room, it is sometimes necessary to deflect the air toward the center of the room. Deflection settings in an upward or downward direction are also provided by various register manufacturers in order to make certain that the movement of the conditioned air will be in the proper direction.

The type of deflection necessary on any register will depend upon the register location and the requirements of the particular applications. It is advisable to provide registers of the adjustable type on most installations, since they permit settings to be made after the installation is completed. Sometimes unforeseen heat load concentrations require a register adjustment after the installation is made to provide proper air distribution in the conditioned space.

Register Location

The difference in problems presented by the various air conditioning installations prevents the recommendation of any specific type register location that will guarantee maximum efficiency under all conditions. From the standpoint of drafts and proper air distrib-

ution, it is impracticable to recommend any register location that will produce the best results for installations designed exclusively for summer cooling, exclusively for winter heating, or for combined cooling and heating.

A discussion of the factors which affect register location, and a comparison of the relative merits of the various types of register locations when used for heating, cooling, or combined heating and cooling, should assist the installer in selecting the proper supply and return locations to fit any specific installation.

Winter Air Conditioning Problems

Gravity Flow of Air—The supply register air temperature is always above the design room temperature (usually 65 to 75F). The warm air leaving the register face has a tendency to rise and stratify near the ceiling. To prevent the cold air from settling at the floor level while the warm conditioned air stratifies at the ceiling, it is necessary to mix quickly the conditioned air with the room air.

Stratification—Any air entering through the windows and exposed walls during the winter season collects at the floor level. Hence, whatever stratification occurs during the heating season seems to be most extreme within the occupied zone.

Rules Governing Supply Register and Return Grille Locations—In the location of supply registers and return grilles for winter heating, there are two elementary principles which should be adhered to as closely as the particular installation will permit.

Air should be blown over exposed walls in sufficient quantities to mix the warm conditioned air with any cold air infiltering through exposed walls or windows so that the tendency of the cold air to settle near the floor is counteracted by its mixture with the warmer air.

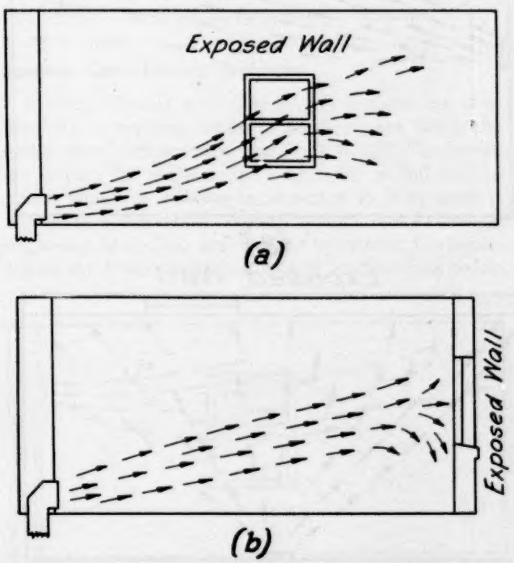

Fig. 5. Warm air is distributed to wash the exposed outside walls as illustrated. Air is discharged in a direction parallel to the exposure.

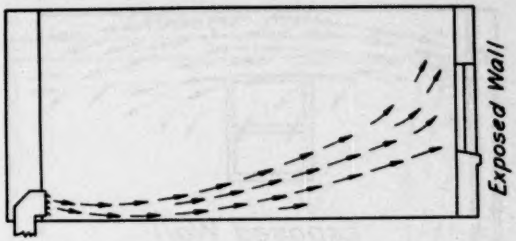

Fig. 6. By deflecting air downward, a greater throw in a horizontal forward direction may be expected.

Returns for heating should be placed as closely as possible to the source of heat loss, such as windows and exposed walls, so that infiltering air from windows and exposed walls can be returned to the conditioner before it has an opportunity to pass over the floor level and cause discomfort to the occupants. Returns for heating should be located so that the air must not be pulled any great distance. It is well to remember that the control of air motion is not applicable in the case of return openings, since a high velocity of air movement at the face of the grille represents a very small movement of air at a distance approximately 3 ft in front of the grille.

Relative Merits of Supply Locations—With the baseboard register (straight flow type), warm air discharged into the conditioned area from a point near the baseboard gives very satisfactory operation and results in an acceptable temperature differential between floor and ceiling level. Registers of the straight flow type, when located near the baseboard level, must use face velocities not greater than 300 fpm or objectionable drafts will be set up within the occupied zone. Warm air from supply registers should be so distributed that the warm air washes the exposed (outside) walls in a manner similar to the arrangements shown in Fig. 5 *a* and *b*.

The distribution of warm air, shown in Fig. 5a, is accomplished by discharging the air along the exposed wall in a direction parallel to the exposure. The method of distribution, shown in Fig. 5b, discharges the warm conditioned air toward the exposure and produces the same blanketing effect as the previous method of distribution. Due to the limitation on the face velocity, 300 fpm, of this type of register location, the warm air has a tendency to rise toward the ceiling after it has traveled a short distance from the register face. Since the air rises as soon as it has lost its velocity as a result of imparting its energy to the room air, this type of register location cannot be used for applications that require the conditioned air to be thrown very far in a horizontal forward direction.

With a baseboard register (vanes deflected downward), if the warm air is discharged from a point near the baseboard with the vanes of the register deflected toward the floor, it is possible to reduce the temperature gradient between the floor and ceiling of the conditioned area. The principal advantage of this type of register over the straight flow register is its adapta-

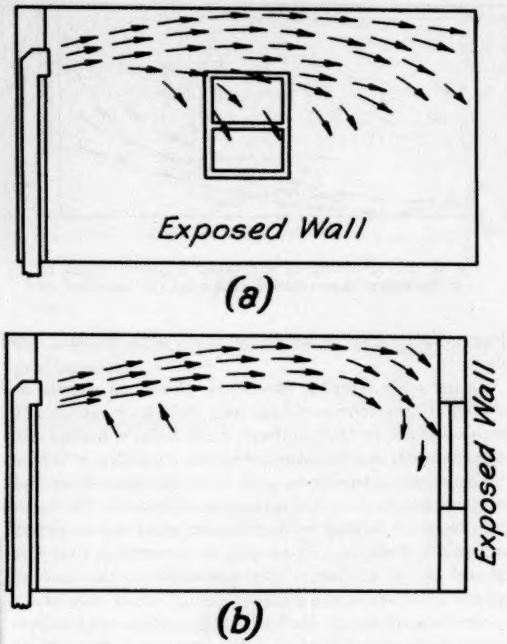

Fig. 7. High sidewall registers discharging warm conditioned air along an exposed wall.

tion to face velocities as high as 500 fpm without causing objectionable drafts within the occupied zone.

When the air is given a downward deflection, as shown in Fig. 6, it is possible to use smaller size registers and a greater throw of air in a horizontal forward direction may be expected. Baseboard registers should always be located so that discharged air will not be dampered or deflected by furniture in the room.

High sidewall registers (straight flow type 6 to 7 ft from floor line) discharging warm conditioned air along an exposed wall, Fig. 7a, or toward the exposure, Fig. 7b, will give satisfactory results when the velocity of air leaving the register face is not less than 500 fpm.

Register face velocities less than 500 fpm should not be used with the high sidewall type of location or a stratification of cold air will persist at the floor level.

The register locations shown in Fig. 7 can be illustrated more clearly by plan views of these arrangements, as in Fig. 8.

The arrangement shown in Fig. 8a utilizes a two-way deflecting register to direct the path of the warm air against the exposed wall. Arrangement shown in Fig. 8b utilizes a three-way deflecting register to blanket the outside wall. It is important to understand the possibilities afforded by the use of deflecting registers, since construction difficulties may definitely fix the location of the register. When discharging warm air against the exposed wall similar to the arrangement shown in Fig. 8b, the throw of the register must not be too great or the conditioned air will rebound from the opposite wall and cause objectionable drafts within the occupied zone.

It is sometimes necessary to utilize a high sidewall location on an installation where the throw is very short. In this case, it is advisable to reduce the throw of the register by deflecting the face bars to the right or left, or reducing the face velocity of the register. If the face velocity of the register is reduced below 500 fpm, great care must be exercised to prevent stratification.

With the high sidewall register (vanes deflected downward), a downward deflection of 15° of the warm air stream leaving a high sidewall register tends to force the air flow downward and reduce the possibility of stratification within the conditioned area. However, a downward deflection of the warm air stream, similar to Fig. 9 may cause objectionable drafts within the occupied zone.

Return Grille Locations—Due to the tendency of cold air to fall, it is important that return grilles should be located at the lowest point in the conditioned area. A sufficient number of returns should be provided so that the air does not have to flow a great distance. It is not good practice to pull air through one room to another in order to reach the return opening. Return grilles which cause air to flow a great distance usually cause a stratification of cold air upon the floor of those rooms through which the air is being drawn.

If possible, it is advisable to locate one return opening in all rooms that are subject to a large amount of infiltration from exposed walls and windows. Whenever possible, the returns should be located in the outside wall so that infiltering air can be drawn into the conditioner before it has a chance to stratify on the

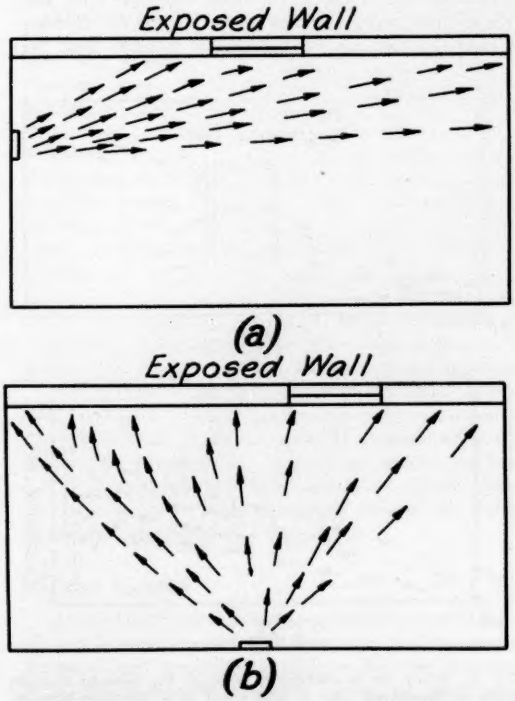

Fig. 8. Plan views of register locations shown in Fig. 7.

floor level. Fig. 10 shows two arrangements which may be used when two exposed walls are encountered. Particular attention should be given to the location of the return grille.

The distribution of warm air in Fig. 10a is accomplished by discharging the conditioned air along each of the exposed walls from separate supply openings. The return grille is located at the outside wall so that cold infiltering air is pulled into the conditioner before it can pass across the floor level.

The arrangement shown in Fig. 10b utilizes a single supply outlet with the bars of the register face deflected in such a manner as to cause a blanketing of the exposed walls with warm air. The return is located in the same position as shown in Fig. 10a.

In small, compact houses, where all rooms on the first and second floors are connected to a central hall, construction difficulties or economies may limit the number of return openings that can be used. It is possible to obtain fairly satisfactory results in compact homes by locating a central return grille in the first floor hallway. The quantity of air to be returned, however, may necessitate the use of a return grille of such dimensions as to cause an objectionable appearance or noisy operation. It is, therefore, advisable to divide the return air so that a portion of it can be returned either in the second floor hall or in the risers at the top of the stairs.

Warm air heating systems which use a high wall outlet should have a larger number of returns than one using baseboard supply outlets, due to the tendency of the former toward stratification.

Return openings should not be located in kitchens or bathrooms, nor any sections of the home where odors or smoke might be drawn into the conditioning system. Kitchens and bathrooms, when heated by warm air, should be properly vented to the outside to prevent the distribution of odors throughout the home.

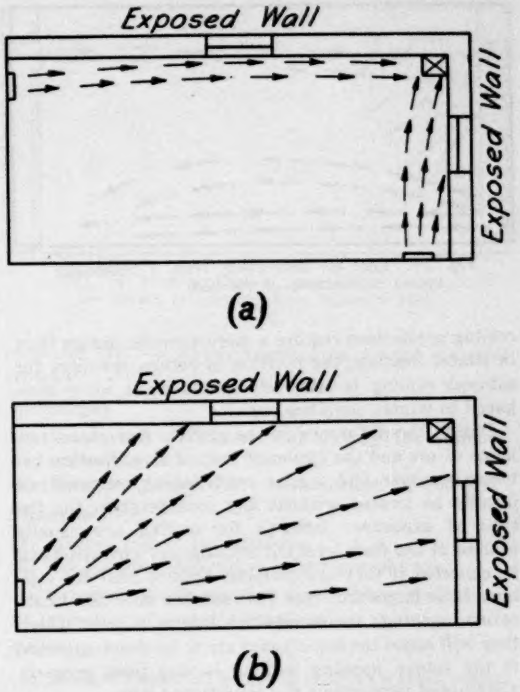

Fig. 10. Two arrangements which may be used when two exposed walls are encountered.

Summer Conditioning Problems

Gravity Flow of Air—The supply register air temperature in summer conditioning is always below the design room temperature, usually 12 to 18F. The cooled air leaving the register has a tendency to fall rapidly unless sufficient velocity is imparted to it to keep it moving in a horizontal forward motion. It is extremely important in cooling applications to prevent the conditioned air from falling too rapidly and causing objectionable drafts a few feet from the register face. High temperature differences between floor and ceiling are not usually encountered in summer conditioning.

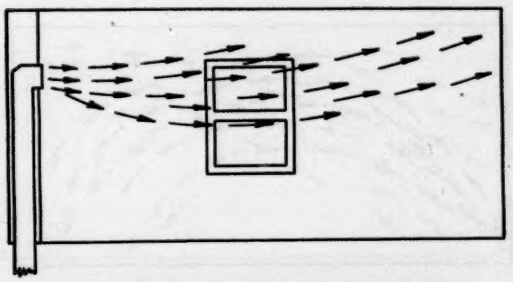

Fig. 9. Downward deflection of warm air, as shown, may cause objectionable drafts.

Stratification—The natural tendency of warm air to rise causes the infiltering air, during the summer season, to collect at the ceiling level. This collection of warm air at the ceiling in cooling applications causes the most extreme stratification of the air to occur above the occupied zone. The stratification at the ceiling has no effect upon the comfort of the individual and has even been found to provide an additional resistance to the flow of heat in through the ceiling on some installations.

Rules Governing Supply Register and Grille Location—In summer cooling, the only fundamental principles upon which to base the location of the supply outlet is to discharge the conditioned air to the part of the area where the heat gain occurs. The solution of distributing the air for a cooling application requires an analysis of the various heat sources which constitute the cooling load. The heat gain for a summer cooling application will be found to be more evenly distributed throughout the area to be conditioned. A portion of the heat gain will occur at the exposed wall surfaces and windows; another portion will result from the increased temperature of objects within the room, due to the direct sunlight shining through unshaded windows; while still additional heat will result from the presence of individuals, lights, cooking equipment, and electrical apparatus within the conditioned space.

While the location and type of supply openings in a

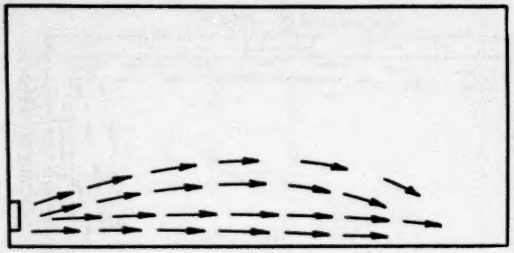

Fig. 11. Cool air discharging from a baseboard, settling at the floor.

cooling application require a more accurate design than in winter heating, the position of return openings for summer cooling is relatively unimportant when compared to winter conditioning.

Due to the difference in the gravity flow characteristics of air and the tendency toward stratification between summer and winter conditioning, returns can usually be located without any consideration for the type of exposure. Returns for cooling are usually located at the floor level but satisfactory operation can be expected if they are correctly applied near the ceiling. It is important that the installer does not locate return openings for summer cooling at a point where they will cause the conditioned air to be short-circuited to the return opening without having been properly distributed throughout the conditioned area.

Relative Merits of Supply Locations—With a baseboard register (straight flow type), the horizontal discharge of cool conditioned air from a register located near the baseboard level will produce very unsatisfactory results, since even at very low face velocities a stratification of cool air will collect at the floor. Fig. 11 illustrates a baseboard discharge with the cool air settling at the floor.

With a baseboard register (vanes deflected upward), if the bars of the register face are given a deflection upward of approximately 60° from the horizontal, similar to Fig. 12, higher face velocities and less stratification of cold air will result. The method of discharge shown in Fig. 12 cannot be utilized whenever the type of installation requires the air to be thrown very far in a horizontal forward direction.

With a high sidewall register (straight flow type), the discharge of cool conditioned air in a forward horizontal direction from a register location 6 to 7 ft from the floor level appears to give the most satisfactory results for summer air conditioning, since the cool conditioned air tends to fall to the occupied zone a short time after it leaves the register face, Fig. 13. The distance that the air travels in a forward direction before it enters the occupied zone will depend upon the face velocity of the air at the register, the temperature of the conditioned air, and the type of register selected.

When the register is properly selected to fit a specific application, the cool air gradually falls toward the breathing zone as it moves in a forward direction. The forward movement of the conditioned air causes it to set up a secondary movement of room air, thereby reducing its own velocity by imparting its energy to the room air. At the same time, the cool conditioned air is tempered by its mixture with the room air and finally enters the living zone without objectionable drafts and spotty temperature conditions. The register velocity must be such that the main air stream will not drop too rapidly and thus be directed onto the heads of the occupants. On the other hand, the register air velocity must not be such that the main air stream will rebound from the wall opposite the register and cause objectionable drafts similar to currents in Fig. 14.

Combined Winter and Summer Conditioning Problems

A single register location that will provide satisfactory conditions for year-round residential air conditioning presents a combination of the problems encountered in the location of registers for installations designed exclusively for heating and exclusively for cooling. Relative merits of the high sidewall and baseboard type register location in respect to their effect on the comfort of the occupants within the conditioned area were discussed.

When a register location is to be selected to fit a specific application for year-round conditioning, it is necessary to give consideration to several factors in addition to the requirement that a register produce comfortable conditions within the living zone. It is essential that the following points be given consideration when selecting a register location, since all types of installations will be affected in some manner by at least one of these factors:

1. Economics of the installation
2. Construction difficulties
3. Peculiarities of the application
4. Relative importance of heating and cooling functions

Economics of the Installation—The desire of the purchaser to limit his expenditure for an air conditioning system will definitely affect the type and location of both the supply and return openings. Locating supply and return openings near the baseboard result in an installation that is less costly than the high sidewall register location, since shorter lengths of supply ducts are required. Furthermore, the increased duct length necessary for high sidewall locations causes a decrease in the temperature of the supply air leaving the register face (winter conditioning), thereby increasing the required cfm of conditioned air to be circulated.

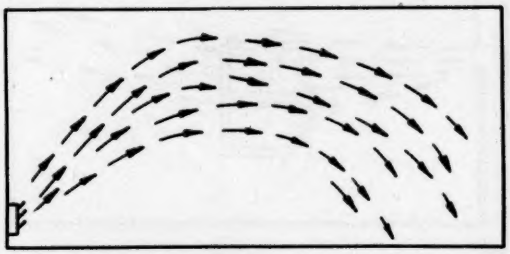

Fig. 12. Path of air flow when vanes of a baseboard register are deflected upward.

Construction Difficulties — In locating the supply register, the problem of available space always confronts the installer. The only available wall in a room is sometimes obstructed by a built-in cabinet or bookcase occupying the lower part of the wall, in which case a high sidewall location is unavoidable. Where outside walls or partitions are constructed of brick, stone, or concrete blocks, the location of the supply register will be governed by the possibility of installation. Some register locations may be influenced by the cutting and reinforcing of beams, studs, and other structural framing, while other locations may be rendered impractical because of the need of special duct fittings.

Peculiarities of Installation—Every air conditioning installation contains requirements that are applicable only to the installation under consideration. In long narrow rooms where the register can be located only at one end of the room, it is necessary to use the high sidewall location so that the high velocity air stream will carry to the opposite end of the room.

The use of baseboard register outlets places limitations upon the arrangement of the furniture within the conditioned area. High sidewall register locations are not affected by the position of the furnishings. In some applications, the customer definitely stipulates the type and location of the supply register, since he wants its appearance to blend with the room decorations.

In the selection of the proper register location for year-round conditioning, there is no more vital point to be considered than the relative importance of the heating function of the system as compared with the cooling function. It is, therefore, essential to know what portion of the year will be devoted to heating and what portion to cooling. Installations located in the northern latitudes will be required to furnish heated air for a period of approximately 8 months, while in southern latitudes the cooling function may be far more vital to comfort.

Summary

The following outline is a summary of the advantages and disadvantages of the various types of register locations that might be used for year-round conditioning.

A dual system of registers in which the warm air is supplied by a baseboard register of the diffusing type and the cool air is supplied by a high sidewall register.

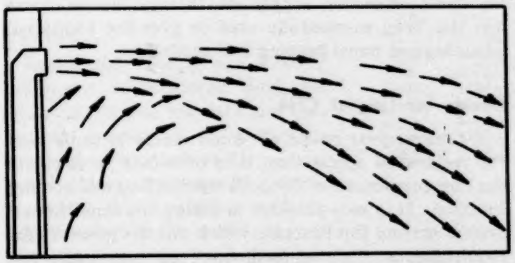

Fig. 13. Cool air discharging from a high sidewall register, 6 to 7 ft from floor.

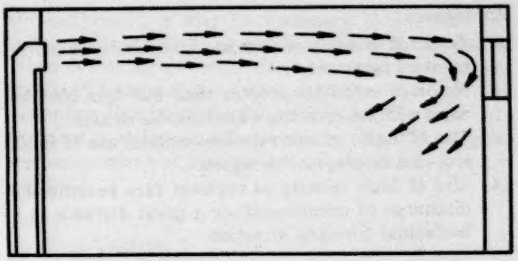

Fig. 14. High air velocity from register causes air stream to rebound from opposite wall.

Advantages

(1) Very good air distribution during the summer season.
(2) Minimum temperature stratification in winter.

Disadvantages

(1) Higher cost of installation.
(2) Construction difficulties might prevent use.

Baseboard supply register discharging conditioned air from a point near the baseboard.

Advantages

(1) A short riser duct length that offers a small resistance to air flow.
(2) Minimum temperature drop of the conditioned air between the bonnet and register during winter operation.
(3) Lowest cost of installation.
(4) Temperature gradient in the room during the heating season is minimum for register air velocities less than 300 fpm when straight flow registers are used.
(5) Location of register is accessible to home owner for easy manual operation.

Disadvantages

(1) Baseboard location may interfere with the placement of furniture.
(2) Objectionable draft may be created in front of the register during the heating if a straight flow register is used with an air movement greater than 250 fpm. Diffusing registers which spread the air downward (approximately 15° to the horizontal) help overcome winter drafts when the velocity of air movement is increased to 500 fpm.
(3) A stratification of cold air will occur along the floor level when a straight flow type baseboard register is used for summer cooling. A deflection of the bars of the register in an upward direction (approximately 60° to the horizontal) will eliminate objectionable drafts resulting from cold air stratification during summer operation.
(4) The baseboard register location cannot be used when conditioned air must be thrown a great distance in a horizontal forward direction.

High sidewall supply registers discharging conditioned air from a point approximately 6½ ft from the floor level.

Advantages

(1) Location of register does not interfere with placement of furniture.
(2) Register velocities greater than 500 fpm may be used without creating objectionable drafts.
(3) Use of high register velocities enables use of small size and inconspicuous register.
(4) Use of high velocity at register face permits the discharge of conditioned air a great distance in a horizontal forward direction.

Disadvantages

(1) Use of longer riser duct entails greater resistance to air flow, larger cost and larger drop in temperature between bonnet and register during winter operation.
(2) Register may not be accessible to home owners who desire to close it at night.
(3) Temperature gradient in room may be greater during winter operation if the register air velocity is allowed to drop below 500 fpm.
(4) Air issuing from the register may cause streaks to form on the ceiling unless the air flow is deflected.

Floor supply registers discharging conditioned air from the floor toward the ceiling.

Advantages

(1) Short riser duct length offers small resistance to air flow and minimum installation cost.
(2) Temperature drop of conditioned air between the bonnet and register face is at a minimum during winter operation.
(3) Satisfactory winter operation when so located that the air wipes the exposed walls at a velocity of approximately 300 to 400 fpm.
(4) Reasonably satisfactory summer operation when air velocities between 500 and 800 fpm are used.
(5) Easy manual operation of the register.

Disadvantages

(1) Vertical discharge of cold air during summer operation may cause a collection of cold air at one point in the room. (A deflection of the register face at a slight angle to the right or left of the vertical will help to prevent this spotty condition.)
(2) Location may interfere with the placement of furniture.
(3) Location may cause the register to be a collector of dirt and debris. Floor location causes a reduction in available floor space within a room.
(4) Applications which require the conditioned air to be thrown in a forward horizontal direction cannot use the floor type register.

Duct Design

Structural conditions in residences limit the size of stacks, branches and mains that can be used. Table 2 has been compiled as a sizing guide for residential construction. Room partitions and side walls are usually framed with 2 x 4-inch studs placed on 16-inch centers. For this reason the following stack sizes have been selected: 3½ inch x 8 inch, 3½ inch x 10 inch, 3½ inch x 12 inch, and 3½ inch x 14 inch. Often the depths of mains and branches are limited by the headroom available in the basement and therefore this dimension has been fixed at standard depths of 6 inches and 8 inches.

Liberal use of dampers controlling air to branches and individual outlets are recommended. They provide the necessary means for proportioning the air to individual rooms according to the sensible load requirements. It is not possible, within practical design limitations, to size the branch ducts and outlets exactly correct for the desired air distribution. It is therefore necessary to balance the system after it has been installed to insure that each outlet is handling the proper cfm of air indicated by the load estimate. The return air system should be balanced as well as the supply.

In a year-round system using common distribution ductwork, the air should be balanced for both the heating and the cooling requirements. The damper positions should be marked for each requirement. Thereafter the system can be converted for either duty by positioning each damper according to the appropriate markings without the need for making further air measurements.

It is customary to cover cold air supply ducts run through unconditioned spaces with at least one inch of insulation to reduce losses and prevent sweating. Heating ducts are not always insulated when run in basements. Heat loss from the ducts contributes to warming the basement which is considered desirable. Insulation may be required when the same ducts are used for cooling, to prevent excessive losses and sweating.

Ductwork run in unoccupied attic spaces should always be insulated. Even if attic ducts are insulated, a 10% loss of cooling capacity and 25% loss of heating capacity should be allowed for air handled by these ducts. To reduce losses it is often desirable in single-story houses to run supply ducts beneath a central hallway ceiling and fur-in with a subceiling. Fig. 3 illustrates a simplification of this arrangement where sheet metal ducts have been eliminated by using the furred-in space fabricated of noncombustible material as a supply plenum. This type of construction offers an inexpensive and practical method of distributing supply air in a home with a central hallway.

Supply ducts can also be run under the floor in single-story homes without basements but with a crawl space beneath the house. From a heat loss standpoint, under-house-locations are preferable to attic-run supply ducts. Running supply air through hollow floors has also been successfully used to give the additional advantage of panel heating and cooling.

Design for Largest CFM

Whenever year-round air conditioning is to be used for residential application, it is necessary to calculate the cfm requirements for both the heating and cooling function. It is safe practice to design the conditioning system around the function which has the greater cfm requirements. This method, however, may cause the first cost of the system to be penalized, since larger duct sizes may be required if the year-round condition-

ing system is designed around the function that the customer considers the least important.

In southern latitudes of the United States, cooling usually constitutes the major part of the year-round conditioning load. Residential installations located in this section of the country usually require a greater design cfm for the cooling function than for the heating. This result makes it necessary to design the system upon the cooling function but the degree of cooling should depend entirely upon the desires of the customer. It must be remembered that the design of any year-round conditioning system must not be based upon an air quantity (cfm) that will tend to slight the heating function of the system.

TABLE 1—RECOMMENDED VELOCITIES FOR RESIDENTIAL AIR CONDITIONING.

Ducts	Velocities, Fpm
Supply mains	800–1000
Branch ducts	600–800
Risers	350–500

In northern latitudes, heat is required over a period of 7 to 9 months; while cooling is used only during a portion of the summer. Due to the relatively short cooling season as compared to the heating season, the customer may be satisfied to permit the design of the year-round conditioning system to be based upon a summer inside design temperature that is higher than the usual value. In other words, the customer may permit the design of the summer cooling to be based upon a 10 deg differential between inside and outside design temperatures rather than the usual recommended 15 deg. In no case may the design cfm requirements for the year-round conditioning system be less than the value specified for the heating function.

Duct sizes in residential work can be determined satisfactorily by assuming velocities in the various duct runs. Recommended velocities are listed in Table 1. To keep velocity losses to a minimum, air velocity should be reduced consistently from the conditioner to the outlet register.

Table 2 gives recommended supply and return duct sizes in main, branch and riser ducts for various air quantities. The duct proportions have been selected to conform to residential construction practice and basement headroom limitations.

Controls

Residential cooling and heating equipment is furnished with the essential controls for safe and convenient operation. In combining standard components to form year-round systems, it is usually possible to utilize these existing controls. Additional controls cannot be justified in low cost residential air conditioning. However, in some cases, due to the remote location of the equipment, it may be necessary to augment the standard controls to provide convenient operation. When designing a system with a centrally located room thermostat and selector switch for summer and winter operation, it is important to understand the basic differences in the electrical circuits for direct-fired heating equipment and mechanical air conditioning equipment.

Heating Controls

Low voltage controls are universally used with direct-fired heating equipment, since the electrical circuits or devices to be actuated have low power requirements. Remote and automatic control over the equipment can easily be obtained by an inexpensive, low voltage room thermostat. Due to the low voltage requirements, connecting wires are small size and need not be run in conduit.

In direct-fired furnaces the room thermostat controls the flow of fuel to the furnace. The device controlled may be a solenoid type gas valve in the case of gas-fired furnaces, or the oil burner pump and blower in case of the oil-fired furnace. A more elaborate modulating type of control valve is sometimes used with gas fuel. Provision for automatic igniting of the fuel is a part of the standard furnace controls. Also included is a device for cutting off the flow of fuel in the event of an ignition failure, to prevent accumulation of fuel in the combustion chamber or occupied space that would constitute a fire hazard.

Automatic ignition of the fuel is accomplished in the gas-fired furnace by means of a continuous burning pilot. For an oil burner it is accomplished by a high voltage electric arc.

Regardless of the type of fuel used, the fan controls on all direct-fired furnaces are essentially the same. It

TABLE 2—DUCT SIZES.

CFM	Size of Stack or Riser Duct	Size of Branch Duct			Size of Trunk or Main Duct	
	Supply or Return, Inches	CFM	Supply or Return, Inches		CFM	Supply or Return, Inches
50	3–½x6	100	6x6	8x4½	750	6x24 8x18
60	3–½x8	110	6x7	8x5	800	6x25 8x19
70	3–½x8	120	6x7	8x5	850	6x27 8x20
80	3–½x10	130	6x7	8x5	900	6x28 8x21
90	3–½x10	140	6x8	8x6	950	6x29 8x22
100	3–½x10	150	6x8	8x6	1,000	6x30 8x23
110	3–½x12	160	6x8	8x6	1,250	6x36 8x27
120	3–½x12	170	6x8½	8x6½	1,500	6x40 8x30
130	3–½x14	180	6x8½	8x6½	1,750	6x45 8x34
140	3–½x14	190	6x9	8x6½	2,000	6x50 8x38
150	3–½x14	200	6x9½	8x7	2,250	6x55 8x41
160	3–½x14	250	6x11	8x8	2,500	6x60 8x45
170	3–½x14	300	6x13	8x10	3,000	6x66 8x50
		350	6x14	6x11		
		400	6x16	8x12		
		450	6x18	8x13		
		500	6x19	8x14		
		550	6x20	8x15		
		600	6x21	8x16		
		650	6x22	8x17		
		700	6x23	8x18		

is customary in residential heating to operate the fan only when the heating element is giving off sufficient heat to maintain the register air temperatures above a predetermined minimum temperature, to prevent circulating cold air and causing objectionable drafts. Automatic operation of the fan is accomplished by a thermostatic switch or fan control located in the furnace bonnet. The cycle of operation of a typical furnace would be as follows:

The room thermostat, calling for heat in the heated space, turns on the furnace firing mechanism. The starting of the fan is delayed until the furnace bonnet temperature is high enough to prevent circulating cold air in the heated space. When the room thermostat is satisfied it cuts off the firing mechanism but the fan continues to run for a period of time until the furnace bonnet is cooled down. The delayed stopping of the fan conserves furnace heat and prevents overheating of the furnace heat exchanger elements. An additional control, usually combined with the fan control, known as a bonnet limit switch, is provided to cut off the burner in case of overheating of the furnace bonnet. This might happen, for example, if the fan failed to operate.

Where a steam or water heating coil is used, the basic principle of operation is the same. The fan operation is under a fan control located adjacent to the heating coil. The room thermostat controls operation of a circulating water pump or a steam valve, depending on the heating medium used. Where a hot water boiler is used, the water is maintained at a predetermined temperature by means of a thermostatic switch, known as an aquastat, immersed in the boiler hot water.

Cooling Controls

The control of mechanical air conditioning equipment differs from heating equipment, since the compressor motor electrical circuits controlled must handle relatively heavy currents. Another important difference exists due to continuous fan operation which is customary for summer cooling duty.

Thermostats for line voltage, and in some cases with heavy duty contacts, are used on air conditioners. They are the remote bulb type with the temperature sensitive bulb located at the cooling coil inlet. The bulb is connected to the thermostat mounted in the air conditioner by means of a length of capillary tubing, usually 5 ft long. The distance at which the thermostat can be located from the conditioner, if removed, is limited to the length of capillary tubing supplied.

Air conditioner compressor motors of capacities up to and including 1 hp have their automatic operation controlled by a line voltage thermostat with heavy duty contacts. Above 1 hp, magnetic compressor motor starters are used in conjunction with a line voltage thermostat. However, in this case the thermostat need not have heavy duty contacts since it will be operating in a pilot holding coil circuit.

Also supplied with the air conditioner is a fan-off-cooling switch. Only the fan operates with the switch in the fan position. The fan and compressor motor both operate with the switch in the cooling position—the compressor being under the control of the thermostat.

It can be readily seen that room thermostat and selector switch low voltage controls for summer cooling can be adapted only by use of suitable relays. In some cases it may be necessary to provide such low voltage controls for convenient operation of the equipment when it is located in places not readily accessible, such as a basement or attic.

Combined Summer and Winter Controls

When it is desired to place all controls at one central location for the owner's convenience in operating the combined heating and cooling system, it is necessary to supplement the controls furnished with the standard heating and cooling components. A panel of such controls would consist of a combined heating and cooling thermostat (or separate heating and cooling thermostats) and a four-position selector switch. The switch would permit the owner to select cooling, heating or fan operation only. The fourth position is off.

When it is necessary to place the control panel a considerable distance from the equipment, it is customary to use low voltage controls so that inexpensive, light wiring can be used. This arrangement requires relays and transformers. However, their cost is usually offset by the saving in wiring costs. Ordinarily all wires run between the equipment room and control panel handle low voltage.

Often zoning, or so-called selective-cooling is utilized in selling low cost air conditioning. Dampers are provided in the distribution system so that the equipment, although undersized to cool the entire house, can be used effectively to cool one zone at a time. In such installations it is usually necessary to locate the thermostat at the conditioner air return to insure that the thermostat is actuated by air being returned from the zone being conditioned. It will not always be possible to use a room thermostat, since it would be necessary to mount the thermostat at a place common to both zones. Otherwise, a thermostat would be required in each zone.

Laws and Regulations Controlling School Heating and Ventilating

NATHAN N. WOLPERT
Associate Editor, Heating and Ventilating

Here is Part 3 of a group of articles covering state laws and regulations drafted to govern the proper design and installation of heating and ventilating systems in schools

Massachusetts

Regulations of the Department of Safety govern the heating and ventilating of school buildings. Any type heat may be used providing it does not contaminate the air within the school or conflict with health, fire or building laws. The air supply must be from an uncontaminated source, free from dust or other impurities.

The minimum allowable fresh air intake opening or flue area shall be calculated on the basis of a maximum air velocity of 400 fpm except where air is supplied through a mechanical system with the intake 6 ft or more above the ground level or where an approved system of air filtration or air washers is installed. With the outside temperature 0F, rooms used for study, recitation and assembly shall have a minimum temperature of 68F with the reading taken at the breathing plane above the floor and 2 ft from an outside wall.

The ventilation system must deliver at least 30 cfm for each occupant. Of this amount, no less than 15 cfm shall be fresh outside air. In every room served, openings with approved regulating dampers shall be provided at floor level for the removal of a volume of air equal to the fresh air volume supplied.

In assembly halls, gymnasiums and galleries, the amount of fresh air supplied and the amount of air removed shall be equivalent to 2.5 cfm for each square foot of floor space. In rooms used solely for gymnasiums, locker, lunch and emergency rooms, natatoriums and shower rooms this can be 1.5 cfm. Air shall be removed near the floor level through ducts equipped with approved regulating dampers.

Individual warm air riser flues shall be used with gravity or central mechanical ventilating systems to serve each classroom. The horizontal velocity of air entering classrooms, domestic science and manual training rooms and laboratories through the fresh air supply openings, should not exceed 350 fpm; for assembly halls or gymnasiums, it should not exceed 500 fpm.

Vent flues should be sized to provide a maximum velocity of 400 fpm for the entering air. Such flues are to be carried through the roof for at least 3 ft above the highest point of the roof or parapet that is within 30 ft of the flue. An exception is where a mechanical ventilation system is installed to serve an attic plenum where attic and roof are of fireproof construction.

Flues are to be installed to ventilate coat rooms and wardrobes. Where a coat room has no access to the corridor except through the classroom, the coat room may be used to ventilate the adjoining classroom. The vent opening should be at the floor level and at the greatest possible distance from an outside wall. The flue serving classroom and coat room shall be 20% greater in area than one to serve only the classroom. Gravity ventilation will not be approved where wardrobes are installed in classroom. Instead, the wardrobes should be ventilated through a flue which can supply not less than 15 air changes an hour. Either a heated flue or a fan may be used to promote air flow. Inlet air openings shall be at or near the floor, the full length of the wardrobe, and equivalent to an opening 4 inches high.

In each vent flue shall be placed an accessible adjustable damper provided with a fuse link and weights so that it can close in case of fire. Manually controlled mixing dampers at the base of warm air risers shall have control chains, pulls, or levers clearly marked to indicate the position of the dampers.

Each chemistry room should have one or more fume cabinets or metal vent hoods over each demonstration table. Hoods and cabinets should be connected through suitable ducts, to a blower. A fume cabinet equivalent to 24 x 24 inches should have a top and bottom vent, each not less than 28 sq in. A hand controlled shut-off damper should be placed in the top opening.

Air supply inlets of gravity systems should be placed on an inside wall, with the bottom of the opening not less than 7 ft from the floor. The vent opening for such rooms should be preferably on the same wall as the supply openings. While approval will not be given to a vent that serves two or more rooms, two or more wardrobes may be served by one vent flue.

Where an indirect heating system is used, with a plenum below the floor, perforated chair or desk standards, or so-called mushroom inlets may be used to deliver air. The exhaust grilles may be located near each corner of the ceiling with means for regulating air circulation and room temperature. Floor openings for the supply of fresh air are prohibited.

An aspirating coil or heater shall be set in each vent flue of a steam-served gravity system of air supply and ventilation, subject to the approval of the supervisor of plans. Steam radiation that is hung in separate room vent flues shall be placed as near the top of the flue opening as possible. Approved stack heaters may be

States not arranged in alphabetical order.

installed at the base of exhaust flues in warm air furnace gravity systems.

New apparatus, specialties or equipment must be accepted by the department before they are installed, and if required they shall be submitted for tests.

Classroom devices supplying air through individual room vertical supply systems shall deliver at least 30 cfm of air per occupant. This air shall be discharged directly toward the ceiling at a velocity not over 125 fpm for each foot distant from the ceiling. The air supply devices preferably shall be located against the outer wall and not less than one-half of the supply delivered shall be fresh air.

Toilet rooms that do not have mechanical ventilation can use heated flues extending through the roof to a point not less than 2 ft above the parapet or ridge. Vent flues and ducts shall be of metal or masonry with smooth interior surfaces and shall be used only for toilet ventilation.

Mississippi

State has no laws concerning heating and ventilating of school buildings. In planning school buildings, it follows the recommendations in the Guide of the National Council on Schoolhouse Construction, Nashville, Tenn. State recommends that glass area in schools be equal to 20% of the floor area and that 50% of this glass area be operable for ventilation.

Missouri

In order for a school to participate in state educational funds, the school must have a modern heating and ventilating system.

The ventilating regulations state that the air in all occupied space should be of the proper relative humidity for the health and comfort of those in the rooms, and the air should be kept in gentle motion. If the air is not preheated and is forced into the classroom, it should be admitted over the radiator or through the radiator. Exhaust air may be removed through the wall opposite the windows, either through ducts of fire resistive construction which lead through the roof; or through grilles into the corridor and exhausted from the top floor through the roof. Special means of ventilation opening directly through the roof shall be provided in toilets, laboratories, shops, kitchens, auditoriums, gymnasiums and places which are sources of objectionable odors and fumes.

Montana

The following information is from Regulation No. 91 of the State Board of Health which carry out sections 1174 and 1175 of the state school laws.

Before it is possible to erect, repair or enlarge a school building, it is necessary to submit plans that will show in detail the ventilating, heating and lighting of the school building and specifications, for approval by the State Board of Health.

The State Board of Health requires that for each pupil in a study or recitation room, there shall be at least 15 sq ft of floor space and 200 cu ft of air space; a system of ventilation adequate to produce satisfactory air conditions in all schoolrooms at all times and under all conditions; a system of heating that shall be considered adequate. The heating system must be capable of keeping the temperature of the rooms at 70F during the most severe winter weather.

The school shall have ample provisions for fresh air inlets, either by suitable window ventilators or other means, and ample means for exhausting used air from the rooms. Except where a mechanical system of ventilation is to be installed to create a positive air pressure within the rooms, no exhaust air ducts shall terminate in the attic but shall be carried through the roof, either separately or after being united in a suitable way. Where the ducts do terminate in the attic, suitable and adequate ventilation shall be provided. Any system of window ventilation shall prevent direct drafts of cold air in the rooms and shall not reduce the window glass area to a point below one-seventh of the floor area.

Ventilation ducts shall be of fire resistant construction; metal or masonry is acceptable. All connections to fans and other appurtenances shall be of fire resistant material or impregnated so as to be fire resistant.

Toilet rooms shall have a ventilation system independent of the system which ventilates the classrooms.

Any controlled mechanical ventilation system that is to be installed shall provide a minimum air movement of 6 air changes per hour.

Nebraska

Although studies are under way which the state hopes will lead to something definite, at present there is little in the way of laws and regulations. The following information is taken from Laws, Rules and Regulations issued by the State Fire Marshal.

Walls and ceiling of the fuel room shall be made of fire resistant materials. This room shall have a fireproof door. The ceiling of the furnace room shall be covered with metal lath and plaster. Furnaces, stoves and pipes shall be not less than 18 inches from any wood protected with asbestos or metal. When stoves are used, the floor under the stove shall be protected with a metal covering that shall extend at least 18 inches in front of the stove, and the stove shall be so placed that exits are not obstructed.

Nevada

This state does not have laws governing the heating and ventilating of school buildings.

New Hampshire

No regulations governing the heating and ventilation of schools.

New Mexico

According to the regulations of the State Board of Education, the preferred location for furnaces is the basement. The central heating system may employ warm air, steam or hot water. Room heaters are accepted for installation in small schools and these heat-

ers should be so placed and jacketed that pupils cannot be burned or injured through direct contact.

The heating system is to be of sufficient size and so installed to maintain 70F, 30 inches above the floor line in all portions of the building regularly occupied by pupils. Corridors, gymnasiums, shops, and cloakrooms may be given special attention as regards the temperature to be maintained.

The ventilating system is to be a part of the heating system and so designed to supply fresh air and remove foul air from the schoolrooms. Duct openings are not permitted in the floor.

Where only a few pupils are in attendance, special ventilation ducts and devices need not be installed. Window ventilation will be accepted where windows are adjustable. Transparent window deflectors or similar devices are to be provided so that occupants will be protected from drafts. If a smaller volume than 750 cu ft per occupant is provided, a fresh air intake and foul air outlets are to be installed.

New York

The following information is from the Regulations of the Commissioner of Education, as amended in 1947.

Heating systems shall be so designed and guaranteed that when properly installed and operated, they will meet the standards listed in Table 4. Maximum air temperature gradient from floor to 60 inches above the floor shall not exceed 5F and preferably shall not exceed 3F. Air movement in zones of occupancy shall not exceed 25 fpm.

TABLE 4—DESIGN TEMPERATURES FOR VARIOUS ACTIVITIES.

Type of Space	Design Operative Temp., F*	Corresponding Room Air Temp., Ft
Sedentary activity — classrooms, auditoriums, offices, cafeterias	70	68-72
Moderate activity — corridors, stairways, shops, laboratories, kitchens	68	66-70
Vigorous activity—gymnasiums	65	60-70
Special cases—lockers and shower rooms	78	76-80
Swimming pool area	83	80-86

*The operative temperature represents the mean effect of the temperature of the air of a room and its walls.

†The lower figure in each case is for a room with relatively warm walls; the high figure for a room with relatively cold walls.

Where extensive summer use of rooms in a school building is anticipated in any area where outdoor summer temperatures are high, the State Education Department may require the installation of air conditioning systems designed to produce inside temperature as follows:

Outside Temperature, F	Inside Temperature, F
80	75
90	78
95	80

As an alternative to such conditions, the Department may require electric fans or similar apparatus to increase turbulent air movement within such spaces to 100 fpm.

Classrooms should be ventilated to provide a minimum of 10 cfm per occupant. For mild weather, a design factor of 15 cfm per occupant is desirable. Assembly rooms should have a minimum air change of 10 cfm per occupant to remove odors. Additional air change, depending largely upon wall exposure, may be required for good thermal operation in mild weather.

Where there is danger of toxic substances occurring in large concentrations in rooms where odors are likely to be strong, or where overheating is likely to occur, special ventilating equipment shall be installed to relieve the situation, entirely independent of the ventilating system serving the rest of the building.

With the plans and specifications that are submitted to the State Education Department for approval should be furnished a brief, clear and non-technical description of the heating and ventilating system, together with instructions for operation. The Commissioner of Education shall determine whether or not the plans and specifications comply with the Commissioner's regulations.

North Carolina

This state does not have laws or regulations governing the heating and ventilating of school buildings.

North Dakota

This state does not have laws or regulations governing the heating and ventilating of school buildings.

Ohio

Furnaces, hot water heating boilers and low pressure steam boilers may be located in school buildings, providing the heating equipment and the fuel room are located in a fireproof room and all openings to the room are protected by self-closing fire doors. No boiler or furnace shall be so located as to endanger the use of a stairway, elevator shaft or an emergency exit from the building.

The regulations require that a heating system shall be installed which will uniformly heat all corridors, hallways, playrooms, toilets, recreation and assembly rooms, gymnasiums and manual training rooms to a uniform temperature of 65F in zero weather, and which will heat all other parts of the building to 70F in zero weather. An exception is provided for rooms with one or more open sides for outdoor treatment.

The ventilation system shall supply fresh air to all parts of the building except corridors, closets and fuel and heater rooms. Rooms and offices not larger than 200 sq ft in area need not be ventilated. The system shall be capable of supplying not less than 6 air changes per hour in rooms used for instruction and for toilets, and not less than 3 air changes in other parts of the building. In one-story buildings containing not more than 4 classrooms, standard ventilating stoves may be used.

Where wardrobes or lockers are in the classroom, they shall be considered as part of that room and the vent register shall be placed in the wardrobes or lockers. When it is not possible to ventilate such wardrobes or lockers, in connection with classroom ventilation, such spaces shall be separately heated and ventilated.

In general, warm air registers shall be installed so that the bottom of such units is not less than 8 ft above the floor. However, unit ventilators with a good vertical discharge may have the outlet not less than 2 ft above the floor, and floor registers may be used in corridors or lobbies. Vent registers should be placed not more than 6 inches above the floor except in rooms that do not require a direct supply of fresh air. Vitiated air shall be conducted through flues or ducts to be discharged above the roof of the school. Fresh air is to be taken at a point outside the building suitable to provide clean air. The intake shall be above the grade line and properly screened and drained.

Hoods are to be installed over every stove in the domestic science room and over every compartment desk or demonstration table in chemical laboratories and chemical lecture rooms, to carry off offensive odors and gases. Ducts serving the hoods shall be independent of those used for room ventilation. Where electric power is available, electric exhaust fans shall be placed in the ducts or flues leading from such hoods; otherwise steam or hot water accelerating coils shall be installed in the main vertical flues above such ducts to promote air exhaust.

Rhode Island

While the state has no detailed regulations governing the heating and ventilating of schools, there is a provision that the director of education from time to time shall approve proper standards for the heating and ventilating of such buildings.

South Carolina

Requirements of the State Board of Health for the proper ventilation of schoolrooms specify that all classrooms have not less than 16 sq ft floor space and not less than 200 cu ft air space per pupil; the distance from the floor to the top of the windows be not less than one-half of the floor width; all rooms, corridors and halls have a window or door to the outside; all windows to be so constructed that at least one-half of their area may be opened for ventilation. State laws require that each pupil be supplied with 3,000 cu ft of fresh air per hour.

South Dakota

No laws or regulations governing the heating and ventilating of school buildings.

Tennessee

This state does not have published laws or regulations governing the heating and ventilating of school buildings.

Virginia

The following standards and regulations are a combination of statutory laws and regulations of the State Board of Education.

Schools must have a ventilating system that provides 3 air changes per hour.

Buildings with 6 classrooms or more should have a central heating system designed to heat the building by one or a combination of the following methods: Direct steam and forced hot water radiation; unit ventilators; steam coils over which air is blown into ducts to the various classrooms and spaces; panel type radiant heat. Additions to existing school buildings which contain 5 or more classrooms and which do not have central heating system are prohibited except by special State Board of Education approval and except that the addition does not contain more than 2 classrooms.

If direct steam radiation is used for heating, with no positive means for introducing the required minimum of fresh air, then the fresh air shall be brought in through raised windows, over glazed window deflectors, one to each window. Vitiated air shall be exhausted through metal lined or masonry ducts having a continuous run from the floor line of the classroom, or from the ceiling of the wardrobe, through an approved and properly sized ventilator head on the roof. The vent duct shall have a sectional area of not less than 10 sq in. per pupil in the classroom served.

Where wardrobes are used in classrooms, the doors to wardrobes shall be hung sufficiently off the floor to allow a net sectional area of 10 sq in. per pupil. The vent duct shall start at or near the ceiling of the wardrobe and run continuous through the roof.

Radiation shall not project above the window stools and shall be hung on the wall so it is not less than 2½ inches from the wall and not closer than 4 inches to the floor. All direct radiators in classrooms shall be provided with approved radiator shields hung not closer than 2½ inches to the radiator. The heat unit used shall not project more than 15 inches from the face of the wall.

Where unit ventilators are used, they shall be so designed and installed that they will introduce the required minimum of fresh air at all times that the school is in session.

In buildings that do not have a central heating plant, heat shall be furnished by approved jacketed stoves. It shall be possible to bring in the minimum of fresh air while the school is in session.

Toilets in buildings employing window ventilation shall have vent ducts running from the toilet ceiling continuous through the roof. There should be a properly sized vent head over the outlet that will exhaust not less than 3 air changes per hour. The ducts are to provide a sectional area of not less than 50 sq in. for each water closet and urinal in the toilet.

When planning the auditorium, playroom, cafeteria, kitchen and gymnasium, including locker, shower and dressing rooms, satisfactory cross ventilation should be provided as a minimum requirement. In lieu of such cross ventilation, some positive means of introducing fresh air must be provided that will insure a minimum of 3 air changes per hour.

Experience is my Classroom

By T. W. REYNOLDS

Editor's Note. The whole of Mr. Reynolds' column this month is devoted to servicing, trouble jobs, maintenance and similar problems, with and without the author's comments. The column opens with an exposition on the common tendency to blame the manufacturer for everything.

• IT'S THE MANUFACTURER'S FAULT!

Manufacturers' service departments for heating, ventilating, and air conditioning products estimate that from 60% to 90% of their service calls are the result of improper operation or installation of their product, or of some product or equipment other than their own. Few owners seem to realize that a particular kind of equipment is dependent upon other equipment for its satisfactory operation. It may be just a fuse that has blown, yet the first thing usually done when something electrical stops is for the owner to call the engineer, who calls the contractor, who in turn calls the manufacturer to correct the condition.

I must confess that in the hurry of things I, too, have sometimes been guilty of passing troubles along to others. Only recently, I sent a small kitchen radio to the manufacturer for overhauling and shortly received it back with a notation that it was not designed to hold the bits of rag and other items constituting the nest of a mouse.

Since things must have a base, it seems to be generally established that a thing has top and bottom, although even this fact is sometimes overlooked. Things do occasionally get topsy-turvy. Furthermore, most things, like ourselves, have a front and rear, or a forward or backward rotation. This is unfortunate and accounts for many service calls. It seems to be natural to do things unnaturally, rather than by chance right, because there are usually more ways of doing things wrong than there are ways of doing them right. Arrows on equipment showing proper direction of flow or rotation often mean no more to the installer than red or green lights to some car drivers.

So don't be surprised when you pull a light chain and a unit heater starts, or water comes down from the ceiling all over you; nor when hot water flushes the toilet bowl, or comes out of the garden hose. The hot water flow may be due to inoperative check valves on the hot and cold water connections to the shower, so that the hot and cold waters are just circulating around in accordance with natural laws.

What follows in this and some subsequent columns are a few of the most interesting and instructive items I can think of for the moment on more or less foolish calls upon the manufacturer and others of the industry. If one took the time and trouble for a full compilation from service departments he could fill books.

Controls

Most everyone places the blame for difficulties upon imperfect operation of controls. They are supposed to iron out everything, to control things over which they could by no chance have the wide range of control necessary, or any control whatsoever. In the words of one commentator, the manufacturer of controls takes a much more severe beating than any other manufacturer. This is so true that some control manufacturers go to extremes to make things foolproof. Unnecessary service runs into money so that some manufacturers in lieu of one main filter to collect a lot of dirt now provide a safety filter at each control instrument with the objective that it will never collect enough dirt to require cleaning.

Some things must be periodically checked, serviced, and greased. Although most people do realize this, there are too many jobs in which a complete lack of attention is apparent. Too much uninformed attention is the other extreme and so both inattention and too much attention are the two main troubles with controls. Owners who know how to hook up a doorbell think they know all about controls and start to play around with them. As a rule, they do more harm than good and add to the number of service calls. Even the head accountant in a brewery may think he knows all about such things. This is an actual case.

If you find the indicator at 72F and the instruments controlling around 76F or 78F, it is just an assurance that someone has been playing around with the controls. He may have found a control but one degree off and in trying to adjust to some mere fraction of this degree gets the control several degrees off. Plain indication of his interference will be found by the scratches he made inside the control instrument. And don't be surprised if the controls get wired so that the system cools when it should be heating, or vice versa.

With pneumatic controls, there are failures due to lack of cleaning the oil filter in the line or the suction filter on the compressor. As for the air tank, it may not be blown down to free it of moisture, so that it is not long before the air tank gets full of holes, notwithstanding the fact that all other control equipment will still be good for many years.

There are just as many rules and regulations for the design and installation of pneumatic control piping as there are with piping for the flow of steam and con-

densate. Piping must be properly sized, pitched and dripped, and there are serious difficulties where the ceiling is hung before the control contractor is told at the last minute just where the controls are to go.

Operating dampers should be furnished by the control manufacturer to insure proper bearing and tight closure. They cost more, but they are better dampers. Outdoor air intake dampers have a natural way of getting fouled up with incoming dirt because the air is not filtered at that point. This is one reason why a damper motor should be installed outside of the duct.

Damper motors have a way of getting into trouble. The installer often seems confused as to how to hook up the linkage and usually ends up with it backward, and thus the motor acts in reverse. The result, in some cases, has been freezing of the coils in spite of the nice electrical diagram furnished with the shipment. The installer is apt to wrap his lunch up in the diagram and go ahead on his own. Workers like to use tools and not drawings—it takes time to unpack and to read instructions.

One trouble with controls is that they are sometimes found unsatisfactorily adjusted when general construction is complete. The reason for the delay is that the control contractor finds it time saving and in the end more satisfactory to all to wait until the occupancy load is there and other things on the job have been properly adjusted. Who, for example, can do much until the air distribution has been balanced and fixed to some degree, and who can do much about that until the dirt from new construction stops and the dirt-plugged strainers and air filters are cleaned.

Steam Traps

Trying to make a steam trap do more than it should is like driving a car with the brakes on. Usually, the trap is blamed. It does not remove air or condensate as anticipated, yet almost invariably there will be found some inherent defect in the system and not in the trap. There may be a steam main overloaded with water, some small untrapped cross connection between steam and return, a lateral trapped by its own water pocket, or a priming boiler. The vacuum pump may not be operated long enough to get the air out of the system, or the pump runs most of the time on float operation.

Finally, there are lift fittings to lift us out of troubles we erroneously foresee, but which troubles really will not exist in many cases. Such fittings, although very helpful in some cases, cannot push water up regardless of physical conditions or indifferential pressure of operation, so to speak. The trap manufacturer also sells lift fittings, but would prefer they not be used where use may be detrimental to proper trap operation.

Air Filters

Filters, such as those of the permanent washable type, are sometimes found installed backward, thus giving a high resistance in a short time. This places the fine medium of the filter out in front where it catches all of the load. It soon plugs with the big particles which should be stopped by the coarser medium beyond, but if turned right the filter will be progressively packed. Still another trouble is that some allow the resistance of a filter to build up to as much as 1 inch. They then put through a service call because large particles go through due to channeling.

An automatic filter may be as high as 13 ft, yet someone may decide to do his own servicing on it and with any kind of rickety ladder conveniently near. In just such a case the ladder fell, and the worker on it grabbed a crank-arm, breaking it, and his own arm as well. He filed a lawsuit, holding the equipment to be defective, equipment never designed to support a man.

When it comes to electrostatic air cleaners, most people are so afraid of high voltage that they don't want to know anything about it. They will do no servicing, even of the simplest kind. As a result a service man may travel from New York to Rhode Island just to reset a button operator. One service man, thus annoyed, demonstrated his contempt of the high voltage by placing his hand across the filter plates, thus short-circuiting the filters at 6000 volts. He knew how to do it and in a way his body wouldn't take it. He further knew that any short circuit would be of short duration, just a matter of 20 seconds and the apparatus would kick out. Nevertheless, the underwriters of insurance may require more safety switches on an electrostatic cleaner than there is of cleaning equipment. This adds to service calls, for someone doing his own servicing is apt to close some safety device and later forget all about it.

Odor Removers

With activated carbon odor removers there may be a complaint that odors are not fully removed. Examination discloses air leaks by-passing the canisters, air or odors going around them where the canisters are not snugly fitted. Then there may be a complaint of their high resistance when the resistance is imposed instead by other equipment, such as by air filters not properly serviced. Further, the odor removers may be plugged with dirt due to filter sections having been left out to help out the air supply when this becomes too low in quantity. In this event, the odor removers are being wrongly used as filters.

Sometimes the canisters are set too close to oil-coated filters. Oil will then be carried along in the air stream and saturate the canisters. Their life is then gone and they must be reactivated.

Fans

Wood from construction has a way of getting into wrong places and a 2 x 4 is a commonly used piece of wood. So a 2 x 4 is temporarily stored in a fan, then forgotten, and the fan can't run. Someone cannot interpret a wiring diagram, and, as a consequence, wires a fan to run backward. In this event, the fan cannot very well do a good job of dust collection. If, instead, it is used as a heating fan, the place will not be heated. Even the fan on a unit heater occasionally gets so wired that it runs backward. If a supply fan runs, but the exhaust fan cannot cooperate because it has

been shut down, there will probably be odors, but it's not the fault of the supply fan.

Certain sizes of fans shipped knocked down may end up wrongly assembled at the site, despite simple installation requirements and tags with each shipment directing attention to possible trouble. Today a lot of ball bearings are used for fans and these bearings must be properly installed. Sheaves sometimes come improperly bored, causing the fan to vibrate. Then, too, before the installer is off the job, the actual fan speed should be determined, and ammeter and voltmeter readings taken on the motor to determine the actual load on the fan motor.

A second-hand office ventilating fan ran a few moments and odorized a place faster then it ventilated it. Soon I had the manufacturer on the phone, but learning that it was second-hand, called the contractor. The contractor promised to make good so many times that the season for its use passed. Eventually, it was too late for recourse, for the contractor's sheet metal shop had been sold, lock, stock and barrel. Writing to his last known address, reply was received that the contractor had gone to that place from where no answer can come, for he, too, had aged and passed on. Having then to do my own investigating, I found the fan motor to be likewise aged and with broken-down insulation, hence the smoke it emitted before it too passed on.

A complaint comes in about a roof fan failing to function as it should. You find the reason is that the starter has been placed in the year-round unconditioned housing of the fan. There is no saving by such location, except possibly some slight labor in mounting the starter. One had to go all the way up to the roof to start this fan. Starters are designed for a definite ambient or environmental temperature, and for locations where this temperature is constant. In a hot boiler room, a starter can be set for a higher ambient temperature, but in any event the temperature there is practically constant. On a roof the temperature is anything but constant as the season changes or day runs into night. As a result, the trip thermal overload acts prematurely where no overload exists. Then comes the winter, and it will not trip, because the ambient temperature is too low.

(The question of servicing will be continued in this department in a subsequent issue.)

• GAS PIPE LINES

Natural gas from fields in Texas is now finding its way through 1,822 miles of 30-inch pipe to 134th St., in the Borough of Manhattan, New York City. The gas, sold to local utility companies, such as Consolidated Edison, arrives in New York within three or four days of leaving 34 different fields extending along 600 miles of the Texas-Louisiana Gulf Coast.

This project, designed, engineered and constructed by Fish Constructors, Inc., required a total financing of $200,000,000 in private funds. Proposed capacity is 505 million cubic feet of gas per day and this is backed up by reserves adequate for 20 years.

The right of way is normally 75 ft wide but in wooded areas is reduced to 50 ft. Natural and man-made obstacles had to be overcome. The buoyancy of a 30-inch pipe in wet areas is considerable and required heavy cast iron clamps or a heavy wall pipe.

As for muskrats, their huts have been demolished in many a swamp and many a claim for damages has been filed. Already one airplane has fallen and struck the line; and in another case a tug sank on top of it. What bombs or lightning will do to the line remains to be seen, but with little concern since there are main line block valves at intervals of approximately 17 miles, together with pumping stations, and a tremendous storage in the line. These valves can also be closed if a tapping is required for new service.

The right of way is restored to the farmer for his corn or other crops, but the crops are destroyed and paid for should it be necessary to use the way for emergency repairs. Out of way places require housing developments for employees, and at intervals there are towers which, of course, must be lighted, and therefore form a nice aerial highway. Regular patrol of the route for observation is made by company planes.

• BURNING NO. 6 OIL

A recent installation came to my attention where at the last moment an owner decided to eliminate the oil preheaters of his oil-burning system. This action was taken in order to avoid the cost of an attendant (per New York Fire Department regulation) where No. 5 oil is to be burned without the operation of oil preheaters, as can be done, but where such heaters were to be installed, as customary with No. 6 oil.

I think the owner was unduly alarmed about departmental regulations and took them too literally. It is true that such situations can become complicated by an arbitrary inspector who rules that you have the equipment for burning No. 6 oil, therefore must make full compliance. It is also obvious that the department cannot have inspectors on a job to note whether an owner has changed from No. 5, he says he 's going to use, to No. 6 he can and may eventually use.

Rulings get clarified as time goes on and the Fire Department in actuality seems to have a fairly elastic attitude. If one has the required certificate of someone qualified, which I believe costs but five dollars per year, he is not apt to be troubled by any inspector. The man who is certified need not be a licensed engineer. He need not know very much, and mainly what is required is just his picture on a little card saying that he runs the oil burners.

The departmental rules in substance are that a heating system *not fully automatic* when operating, and in which the oil is preheated, shall be under the direct supervision of some person holding a certificate of fitness. This person shall be in the *building* at all times while the burners are in operation; however, no such certificate is required if the plant is operated by a licensed engineer.

The National Board of Fire Underwriters have similar rulings, except that there must be a *competent attendant* constantly on duty in the *room* where the burners are located when these are in operation. If there is no attendant, then the burners must be equipped with approved automatic means for preventing abnormal discharge of oil at the burners.

Abstracts AND Reviews

Publications abstracted in this department should be ordered direct from publisher.

LABORATORY DESIGN

Laboratory Design contains the information collected by the Committee on Design, Construction and Equipment of Laboratories of the National Research Council. Its editor is H. S. Coleman who is chairman of that committee. It is intended to be helpful to achitects and engineers in the design of laboratories for research, industrial and educational institutions.

Each of the 42 chapters of the book was written by a specialist in the field so that the book in its entirety represents the thinking and experience of a large group of technical men. There chapters are grouped into four major parts. Part 1 covers a general discussion of interior construction materials, plumbing, light and power, ventilation, safety measures and furniture. Part 2 covers teaching laboratories, with discussions on site selection, interior arrangements, laboratories for the teaching of analytical and organic chemistry, and those for chemical, biochemical, chemical engineering and metallographic work. Part 3 covers industrial laboratories, with chapters devoted to special types of laboratories and their auxiliary rooms. Part 4 contains concise descriptions of various types of laboratories, complete with plans, sections and photographs.

The chapter on Laboratory Ventilation was prepared by W. C. L. Hemeon, Industrial Hygiene Foundation, Mellon Institute; and the chapter on Plumbing by J. E. York, Building Service Engineer, Stone & Webster Engineering Corp.

Laboratory Design, edited by H. S. Coleman. Cloth bound, 8½ x 11¾ inches, 393 pages. Published by Reinhold Publishing Corp., 330 W. 42nd St., New York 18, N. Y. Price, $12.

THERMODYNAMICS

The first edition of Thermodynamics, by George A. Hawkins, professor of thermodynamics, Purdue University, was first published in 1946. It was intended as a text for a two-semester course in the subject, and by the omission of certain chapters, as the subject matter for a one-semester course.

The second edition of this book is now available. Much new material has been added and a number of the chapters have been completely rewritten. The basic philosophy of the book remains the same in that the author has attempted to achieve a good balance between theory and simple practical applications. An effort is made to show through discussions and examples that the subject can be used in other fields of science.

The subject matter is divided into 21 chapters and proceeds from fundamental concepts and the two laws of thermodynamics, to the gas turbine and jet propulsion, vapor cycles, mechanical refrigeration, general thermodynamics, and an introduction to heat transfer.

Thermodynamics, by G. A. Hawkins. Cloth bound, 5¼ x 8¼ inches, 563 pages. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $6.50.

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CODE FOR PRESSURE PIPING.—Sectional Committee on Code for Pressure Piping B31 of the American Society of Mechanical Engineers has issued a 101-page paper-cover book on code for pressure piping. This covers power, gas and air, oil, district heating, refrigeration, fabrication details and materials. Approximately 40 different engineering societies, trade institutions and government bureaus were involved in the preparation of this code. Included is a booklet on standard qualifications for building procedure and welding operator. American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y. Price, $3.50.

PRACTICAL BASEBOARD HEATING — Practical Baseboard Heating, by Charles H. Burkhardt, heating editor of Plumbing and Heating Journal, is now available as a paper-bound booklet. It has data on the various systems of baseboard heating and tables which show the baseboard ratings as released by the various manufacturers. The material is arranged in three articles. It is intended to serve as a guide to those concerned with the sizing, design, and installation of baseboard heating systems. Plumbing and Heating Journal, 45 West 45th St., New York 19, N. Y. Price, $1.00.

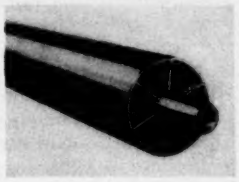
CONSTRUCTION AND EQUIPMENT OF THE HOME.—As part of a series of reports by the Committee on the Hygiene of Housing of the American Public Health Association, a paper-bound book has been published on the Construction and Equipment of the Home. The first volume in this series dealt with planning the neighborhood; the second with planning of home for occupancy; and this, the third and final volume is concerned with the construction and equipment of the home. Material is divided into eight divisions, with a section on problems in heating and ventilating prepared by Dr. C.-E. A. Winslow, professor emeritus of public health, Yale University. There are chapters on structural framework of the dwelling, illumination, control of noise, sanitation, equipment essential for good housekeeping, safety in the home, and legal and administrative standards for dwelling construction. Public Administrative Service, 1313 East 60th St., Chicago 37, Ill. Price, $2.50.

NEWS OF EQUIPMENT AND MATERIALS

Use the prepaid postcard opposite Page 118 for securing additional information on items described in this department.

Radial Fin Tubing

Development of a two-fluid-pass heat transfer surface in the form of concentric tubing with radial fins is announced by the Industrial Division, Modine Mfg. Co., Racine, Wis. Originally designed for an application involving low temperatures and high pressures, CRF tubing possesses characteristics which excellently adapt it to many other uses, such as gas liquefaction, food and pharmaceutical processing, condensing, exhaust heat recovery and heating requirements involving viscous materials. The surface can be fabricated of copper, steel, stainless steel, nickel and other metals in lengths up to 20 feet, and is suitable for a wide range of temperature and pressure requirements. For maximum heat transfer, intimate contact is accomplished by means of fusion bonding of fin and tube elements. Tubing may be equipped with simple T end fittings to provide easy connection to both passes, and can be conveniently arranged in series parallel banks.



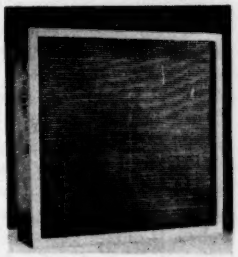
The tubing has been made with 6 radial fins, as illustrated, and in diameters of 1 and 1⅜ inch. Tube geometry can, however, be modified to meet special product or process requirements, including variation in inner and outer tube diameters and fin spacing.

Because of its specialized character, the tubing is currently offered only in production-lot quantities.

For more information, circle on Inquiry Card, **Item 1**

Filter for Dust-Free Areas

A unique air filter, first used by the Atomic Energy Commission to keep radioactive particles out of the air, is announced by Cambridge Corp., Syracuse, N. Y., a new company formed jointly by Arthur D. Little, Inc., Cambridge, Mass., and Carrier Corp., Syracuse, N. Y. The former company developed the filter.



Single filter units will be built to handle 1,000 cubic feet of air per minute at pressures within the capacities of central station air conditioning systems. It will be particularly useful wherever air must be completely dust-free or sterile, as in the manufacture and assembly of precision devices, in hospitals and biological laboratories as well as in pharmaceutical plants.

The filtering medium itself is a special soft and felt-like paper containing sub-microscopic asbestos fibers which direct the air through such tortuous paths that essentially all of the particles become entangled in the fibers. Large sheets of this paper are folded in accordion fashion and fitted into a frame, thereby providing a large filtering surface in a relatively small space.

For more information, circle on Inquiry Card, **Item 2**

Industrial Dust Precipitators

A line of dust precipitators, Series 342, is being made by American Blower Corp., Detroit, Mich. They are designed to handle fly ash, cinders and industrial dusts, and were developed to meet the need and demands of industry for a simple, compact, economical, all-purpose mechanical type dust precipitator.

The units are built in a range of standard sizes with two basic arrangements and can be modified to fit special requirements. The unique design of the unit simplifies field erection as it can be shipped in factory assembled sections which are all match-marked for final erection and assembly.

Bulletin 1728, containing well-illustrated pages and factual information, is available.

For more information, circle on Inquiry Card, **Item 3**

Self-Contained Regulators

A self-contained temperature regulator has been introduced by Barber-Colman Co., Rockford, Ill. Tight closing, rugged construction and self-contained, these regulators offer all the installation advantages of a self-contained controller with the additional features of a clearly marked, calibrated adjusting dial to give exact temperature setting.

The regulators are shipped completely assembled, no assembly, linkage, or adjustment being necessary either before or after installation, except for the simple setting of the control dial to the exact desired temperature.

Units are available in two styles, in sizes from ½ inch through 4 inches. Wiring is a simple two-wire connection to any 115-volt or 230-volt AC circuit.

For more information, circle on Inquiry Card, **Item 4**

Heating-Cooling Thermostat

A new proportional action, capillary heating-cooling thermostat for air conditioning control has been announced by Johnson Service Co., Milwaukee, Wis. Called the T-271 thermostat, it is designed primarily for control of the return air temperature in an air conditioning unit where both the heating and cooling media are regulated by a single valve or damper.

The thermostat, equipped with a liquid-filled, remote bulb temperature measuring element, is mounted inside the air conditioning unit, with adjusting knob and dial either concealed or exposed. The remote bulb, which is connected to the thermostat by a capillary tube, is mounted behind the recirculated air grille where it responds quickly to the average temperature in the room.

During the heating season, the new controller operates as a direct-acting thermostat, closing a normally open valve or damper on rising temperature. The action is reversed during the cooling season, when it opens a normally open valve or damper on rising temperature. The change in action of all, or any number of, thermostats in a building is accomplished by changing the pressure of the compressed air which is supplied to them.

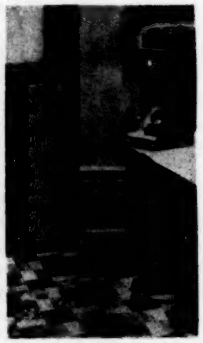
The thermostat is applicable to a variety of automatic control arrangements and types of air conditioning units. Temperature limits are 50 to 185F, with a range of 20F. The thermostat is direct acting at 15 psi and reverse acting at 19 psi supply air pressure.

The capillary tube is 42 inches long, the remote bulb 16 inches long.

For more information, circle on Inquiry Card, **Item 5**

Phone Answering Device

Announcement is made by Electronic Secretary Distributors, Inc., Milwaukee, Wis., of the Electronic Secretary, an automatic telephone answering machine, that answers the phone and takes orders when the office is closed or the owner away.



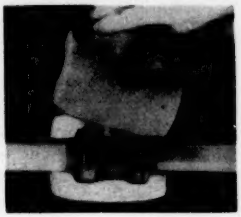
A complete 3-piece unit, the device not only answers the phone automatically, but it takes messages and also tells the caller when his party will return. In case of an emergency at night, the caller is told where he can get service. It is easily installed, as it is not connected to the phone. It is simply plugged in. As an extra feature, the unit serves as a handy portable dictation machine.

One office in Chicago reports that the device records an average of ten orders every week. A Midwest manufacturer's agent had all night calls transferred to his home when the office was closed, thereby receiving all special and emergency calls.

For more information, circle on Inquiry Card, **Item 6**

Molded Pipe Fitting Insulation

A molded insulation, to fit around ells, tees and 45-degree pipe connections, has been announced by Birma Products Corp., Buffalo, N. Y. Molded accurately from Fiberglas, these Birpac fitting insulations combine easy application, neat appearance and low thermal conductivity.



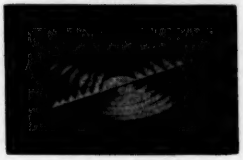
Presently available for all standard sizes of pipe from ½ inch to 8 inches in standard thicknesses, they will soon be available for welding fittings and copper pipe fittings.

Installation of the insulations is described as being as simple as covering a small rubber ball with your two hands. One-half of the fitting is placed on one side of the pipe section and covered with the matching half. The two halves are stapled, wired or taped together.

For more information, circle on Inquiry Card, **Item 7**

High Pressure Air Outlets

A line of high-pressure, aspirating air diffusers, Type HPW-1, is announced by Anemostat Corporation of America, New York, N. Y. The new units are available in three sizes. No. 15 has a neck area of 32.81 sq in. and is rated 80 to 170 cfm primary air capacity at 0.5 to 2.35 inches static pressure. No. 17½ has a neck area of 42.75 sq in. and is rated 105 to 222 cfm at .68 to 3.1 inches. No. 20 has a neck area of 60 sq in. and is rated 145 to 312 cfm at .7 to 3.2 inches of water.



The HPW-1 design is a pre-induction type unit which induces room air, mixes it with the primary air in approximately equal proportions, and discharges the mixture through an aspirating air diffuser.

The new units can be used on air distribution systems which carry air at velocities up to 5,000 fpm and static pressures up to 6 in. High temperature differentials (up to 30 deg) can be handled and temperature difference between primary air and ambient of room air is limited only by dew point to avoid condensation.

Air volume can be manually or automatically controlled. Control valve and sound trap are capable of attonuating duct noise from 90 decibels on the high pressure side to 40 decibels on the low pressure side at a background sound level of 30 decibels.

For more information, circle on Inquiry Card, **Item 8**

Filter Fiber in Bulk Form

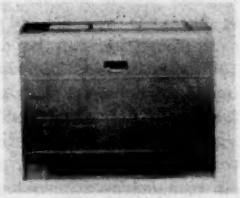
According to an announcement by Glasfloss, New York, N. Y., its glass fiber air filter medium is now available to large industrial users, office buildings and apartment houses or any place where standard disposable air filter units are used. The product, called the Glasfloss Roll-Pak, is the same basic medium made up of long, fine glass fibers. The maker claims that 30% of the cost of an air filter is in the cost of the disposable frame. By eliminating the frame, filter maintenance costs are correspondingly reduced. The Roll-Pak is made up in standard size rolls, 40 inches wide and 10 ft long, in both 1 and 2 inch thickness. It is packed 5 rolls to the carton and provides air filter coverage of 167 sq ft. Coarse wire screening, similar to chicken wire, can be used on both input and output sides of the filter.

Changing filter elements is quickly and easily accomplished. The roll is simply straightened out, cut to size and installed between the screening. The time involved for filter element replacement is reduced over that required for the change of individual framed filters because the strips are cut to maximum lengths, so that a single strip may do the work formerly required by a multiple of single units. Thus, a whole bank can be inserted in a simple operation.

For more information, circle on Inquiry Card, **Item 9**

Convector for Cooling Also

The Flow-Cold convector has been introduced by Acme Industries Inc., Jackson, Mich. The unit is designed for use with Acme Flow-Cold units and is intended for summer air conditioning, or to be used with heat pump systems for year-round air conditioning. It was further designed for floor, wall or ceiling installation.



The convector features three speeds for individual personalized control and provides oversized, slow speed blowers for quiet operation; it requires only electrical and water connections and is provided with large filters.

Ample space has been provided for automatic controls inside the cabinet. All units are 11½ inches wide and 25¼ inches high. The model CV7 is 30 inches long, the CV12 38 inches long and the CV18 measures 62 inches in length.

Cooling capacities with 46 deg water at medium speed are, for the CV7, 7,200 Btu per hour; the CV12 provides 12,000 Btu per hour; and the CV18 furnishes 18,000 Btu per hour. Capacity for heating at 180 deg water at medium speed is 15,700, 26,500, and 39,000 Btu per hour, respectively.

For more information, circle on Inquiry Card, **Item 10**

Ultra-Small Brushes

Exceptionally small cylindrical brushes on a wire axis are available from Walter Borten Co., Peekskill, N. Y. for special applications, a typical sample being a brush with a cylinder of only ¼-inch in diameter. These brushes are made to order or can be adapted or modified for the particular job.

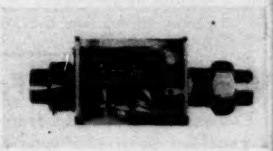
The length of the wire is as required, the brush material can be of horsehair, goat hair, fiber or nylon, wire of galvanized stainless steel, monel metal, or brass, and with various sizes of wire.

Applications of these brushes are for devices which could not be cleaned or properly maintained because of their size and close tolerance.

For more information, circle on Inquiry Card, **Item 11**

Waterflow-Electric Interlock

An improved flow interlock, a device which responds to a flow of water to open or close an electrical contact, has been announced by the Controls Division, General Electric Co., Schenectady, N. Y. It includes a finer differential, union fittings at both ends, a bronze piston, reduced size and weight, simpler adjustment, and more wiring space than the earlier model.



In operation, the device closes a contact when a flow of water exceeds a preset amount and opens it when the flow falls below the preset amount. Working under this principle, it actually acts like a fuse in a circuit which depends upon water cooling for protection. The interlock can be used as a safety device in many applications, including hot water heaters, welding units, kitchen waste units, and induction heating.

Only one screw adjustment is needed to set the circuit for any flow from one-half to four gallons per minute. The flow differential between the cut-in and cut-out of the electrical contact is 0.1 gal maximum. The interlock does not control the amount of water flow. This can be accomplished, if desired, by installing a throttling or regulating valve ahead of the device.

The new control is available complete with union fittings at each end, and a strainer attachment. The strainer keeps foreign matter out of the housing, while the double union fittings simplify installation in a line.

Designed to operate for the amount of flow independent of pressure, the interlock is intended only for cold-water applications. For use with hot water or other fluids, it is recommended that the manufacturer be contacted for more information.

For more information, circle on Inquiry Card, **Item 12**

Portable Oil Space Heater

No smoke pipe or fuel line is required to operate the portable, automatic, radiant type space heater, introduced by Quiet Automatic Oil Burner Corp., Newark, New Jersey.

It is ideal for outside or for inside construction work, or for space heating or drying hay or plaster, and similar applications.

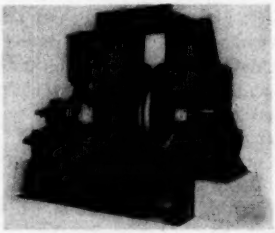
The air is forced through the gun of the oil burner by a motor-driven axial blower. As the air leaves the gun it is split so that part of it moves over the outside of the stainless steel combustion chamber. The other part of the air is used at the nozzle for combustion.

Burning No. 2 fuel oil, from an ordinary drum storage tank, the heater is rated at 200,000 Btu per hour. Complete automatic operation is effected by means of a thermostat at the end of an extension wire. When the 110-volt extension line is plugged in, the unit is ready to operate. Over-all dimensions are 4 x 2 x 3 ft. Rubber-tired wheels are located at one end of the base and a handle at the other end.

For more information, circle on Inquiry Card, **Item 13**

Variable Output Fan Control

Control of fan output from 15 to 100% of full load is provided by a new type of vane control available from Westinghouse Electric Corp., Sturtevant Div., Hyde Park, Boston 36, Mass.



Designed for use with fans for mechanical draft, industrial applications, and ventilating service, this vane control saves power; the vanes close, reduced fan output results in lower motor input. No change in speed of either fan or motor is necessary because vane control changes spin of entering air to modify fan pressure. This provides instant response and permits use of efficient constant-speed squirrel-cage motors.

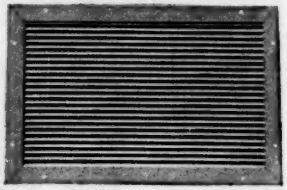
Four models are available: Model 6, used with light duty fans; 7, for handling of dusty gas; 8A, for industrial applications where gases are free from solids; 8B, for industrial and ventilating service where shaft bearings are supported on fan casing.

Heavy steel vanes are welded to tubes that pivot about steel rods. These rods are supporting members for the cast-iron center. The outer supporting member is a rolled-steel inlet flare stiffened to provide rigidity in all directions.

For more information, circle on Inquiry Card, **Item 14**

Louvers Pass No Light

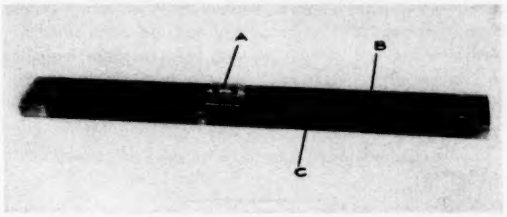
The No-Site and No-Lite door and partition grille, Stock No. 75, has been introduced by A-J Manufacturing Co., Kansas City, Mo. This is a fixed type louver set on 1/3 inch centers made from aluminum or steel and which can be installed in doors, walls, partitions and other opening in any installation requiring ventilation but where light cannot escape or enter. Examples of installations are dark rooms, laboratories, X-ray rooms and blackout areas.



For more information, circle on Inquiry Card, **Item 15**

"Rubber" Scale Has Many Uses

Intended for any engineer who has often wished for a "rubber ruler," the Gerber variable scale has been introduced by The Gerber Scientific Instrument Co., Hartford, Conn. It has a wide range of uses which are explained in a manual which accompanies the scale.



The instrument consists of a conventional scale *B*, a slide *A*, and the variable scale *C*, which is a triangular spring marked on one edge. When the slide is set on the conventional scale to any given dimension, that dimension can be divided into 10ths, 20ths or 100ths on the variable scale. For example, if a drawing is available for which the scale is unknown, which frequently happens in publications, and for which the scale might lie between the 40 or 50 scale on the conventional triangular engineers' scale, the fixed scale is set to a known dimension and the actual dimensions on all other parts of the drawing can be read from the variable scale.

Dividing an odd dimension into parts is accomplished without trial and error by use of this scale, as is reading dimensions from curves based on an odd scale. An example is dividing up of a given dimension for so many rivets.

Odd scale drawing reproduction, calibrating instruments, reading trigonometric functions and derivatives, vector addition, analysis of indicator cards, conversion of units, and many similar problems can be solved by use of this scale.

For more information, circle on Inquiry Card, **Item 16**

Commercial Gas Incinerator

A new, commercial, air-cooled, automatic, gas-fired incinerator, that completely consumes wet or dry garbage and waste material in minutes, has been placed on the market by ABCo Incinerator Corp., Cleveland, Ohio.

The unit, of durable steel construction, consists of an airtight, heavy gage, steel casing interlocked at four corners with upright steel posts. A three-fold insulation system that keeps the heat within the incinerator is accomplished by an insulating material within the case, a 2-inch circulating air space and a 2-inch refractory lining.

A combination grate and burner assembly with a series of thirty-degree-angle openings produces a hot vertical jet flame that consumes wet or dry garbage, trash, rubbish, bones or anything that is burnable. The incinerator burns natural, manufactured, or mixed gases, with fuel oil burning equipment available in areas where necessary. The burner is automatically ignited by a constant low burning pilot fire. A clock that may be preset for a predetermined burning time, automatically controls the burner and stops the flame when the time has expired.

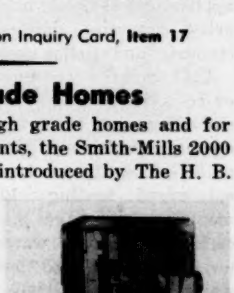
Feed door is of the sliding type that automatically turns off the jet flame of the burner when door is opened and raises or lowers the draft door. A hand shaker actuates the grate, dropping ashes from the grate into an ash pit drawer for easy ash disposal.

The line consists of a low pressure type model and a high pressure type model with a choice of one or two burners. These incinerators are available in either 7 or 15 bushel capacities.

For more information, circle on Inquiry Card, **Item 17**

Boiler for High Grade Homes

Designed expressly for high grade homes and for small commercial establishments, the Smith-Mills 2000 boiler-burner unit has been introduced by The H. B. Smith Co., Inc., Westfield, Mass. It is equipped with a plate-mounted oil burner, with the boiler designed expressly for oil.



The manufacturer claims that the unit is built for those who demand a product better than average, with rugged grey iron sections, a burner made of precision parts, and a longer life combustion chamber. The boiler is designed to permit an extra large amount of domestic hot water through a built-in tank or tankless water heater.

Boiler is of vertical water tube construction, has 1-inch air cell insulation and is enclosed in an attractive two-tone cream and black enamel jacket.

The boiler is available in four sizes for steam and an equal number for water with capacities from 1,210 to 2,210 square foot of hot water, IBR rating, and equivalent in steam.

For more information, circle on Inquiry Card, **Item 18**

Picture Electric Heater

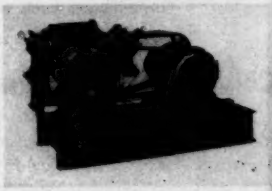
An innovation in interior decoration, combining beauty and utility, is available in a new picture heater developed by Electrofilm Corp. North Hollywood, Calif. The heater can be hung on the wall or set in a detachable base for use on the floor deside desk, crib or chair, and is intended for small rooms or offices, elevator, etc.

The picture heater employs a new type of heating element that permits the entire surface of the picture to radiate heat from a surface temperature below 200 deg, which eliminates possibility of the heater igniting flimsy dresses or draperies or causing severe burns.

For more information, circle on Inquiry Card, **Item 19**

40 Hp Compressor Unit

To fill the gap left between the 30 hp unit and the 75 hp unit introduced last year, a new compact 40 hp compressor has been designed for refrigeration and air conditioning service by Brunner Mfg. Co., Utica, N. Y.



The new compressor, the R-40,000, is adaptable to all types of service in the industry. It is pressure lubricated and fully protected by a device which automatically stops the compressor in the event of an oil pressure failure. It is a 4-cylinder, V-type unit, with cylinders of 4¼-inch bore and 5-inch stroke.

The unit is equipped with a high pressure cut-out which, when properly wired into the control circuit, automatically stops the compressor when the pressure exceeds 175 psi. It can be equipped for unloaded start and the same mechanism will afford four steps of capacity control.

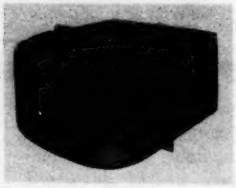
Assembled at the factory either as a motor compressor, Model E-40,000, or as a complete condensing unit, Model W-40,000. The former weighs 2,345 lb, the latter 3,185 lb.

Detailed dimensional drawings and weight distribution figures are available.

For more information, circle on Inquiry Card, **Item 20**

Window Sill Room Coolers

Three improved models of window sill room air conditioners, featuring simplified installation and easy removal for inspection, and a new copper beige cabinet, are announced by Carrier Corp., Syracuse, N. Y. A new hinged cradle-type mounting has been designed which reduces installation procedure to the placing of a few screws for the hinge and outboard supports. The unit slides easily in or out of the mounting for inspection and servicing. The cradle itself can be removed by releasing the wing nuts on the outboard supports and pulling the pins on the hinge, or it can be swung inward so that the window can be lowered for washing by removing the wing nuts.



The Humitrol for increased dehumidifying capacity is available this year for the first time as an optional accessory on room air conditioners. Complete thermostatic control is also available as an optional feature on all models.

The three models are designated as Models 72, 106, and 130, handling cooling loads up to 7,200, 10,600, and 13,000 Btu per hour, respectively.

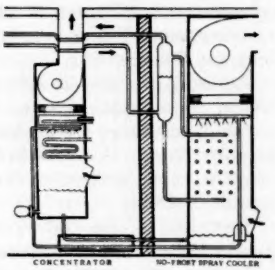
The unit provides cooling, dehumidification, air filtering, circulation, and ventilation. Designed for year-round use, it may be switched to filtered ventilation and circulation only, when cooling and dehumidification are not required. All units have hermetic-type compressors, adjustable outlet louvers for a wide range of draftless air diffusion, replaceable extra-size filters, and sound-proofed cabinets for quiet operation.

For more information, circle on Inquiry Card, **Item 21**

Cold Processing Equipment

A new, improved No Frost unit for refrigerating cold test rooms, cold processing, such as the quick freezing of foods, and for food products chilling and cold storage, is introduced by Niagara Blower Co., New York, N. Y.

The equipment consists of the Niagara spray cooler which provides a controlled cold air stream at sub-zero temperatures by passing air over refrigerated coils that are prevented from accumulating ice or frost by a constant spray of Niagara No Frost liquid, a non-freezing compound. To keep this process automatic and continuous, the non-freezing liquid is maintained in a concentrated condition by constantly removing the moisture that is condensed out of the atmosphere by contact with the refrigerated spray. This is done in the concentrator.



A portion of the solution, as it is continuously being diluted by the condensation of water vapor in the spray cooler, is pumped to the concentrator. Here the water is removed by evaporation. The diluted solution is sprayed in a chamber through which air is drawn by fans. A heating element raises the temperature of the air, promoting the evaporation of the water, which evaporates at a much higher rate than the No Frost liquid by reason of vapor pressure differences. In a second stage of reconcentration, located above the spray nozzles, the air stream, which now contains the evaporated water vapor and some No Frost liquid vapor, is cooled by a reflux coil. This, by increasing the relative humidity of the air stream, forces the condensation of the No Frost liquid vapor. The reconcentrated solution is returned to the spray cooler.

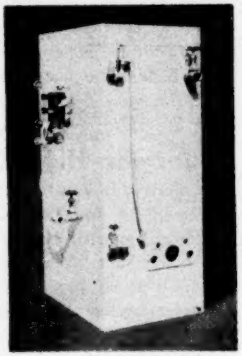
The new concentrator replaces older types in which the water was removed by heating above the boiling point. It has the advantages of operating at lower temperature, increased capacity in smaller space with more compact equipment, easier maintenance, easier and more trustworthy operation with less attention and shutdown time for cleaning.

The new concentrators are manufactured in a wide range of sizes with water evaporating capacities ranging from ½ gallon to 75 gallons per hour.

For more information, circle on Inquiry Card, **Item 22**

Electric Steam Generator

The Custom All-Electric Model U automatic steam generator is being marketed by Custom Engineering Co., Los Angeles, Calif. It is intended for supplying steam needs in such applications as hotels, bakeries, canneries, dairies, laundries and similar uses.



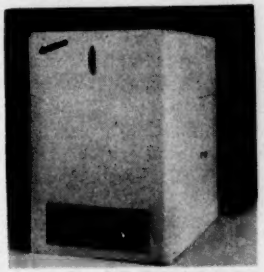
Unit contains no tubes or coils, requires no special boiler room or trained operators and is equipped with bolted flange type submerged heating elements, water gage and cocks, automatic water level controller and low water cut-off, safety valve, pressure switch, pressure gage, pressure gage cock, inspector's test valve, siphon, steam outlet valve, feed water stop and check valves and blowoff valves.

Boiler is of all-welded construction and has 3 inches of insulation and an outer steel jacket. Units are wired at the factory and tested before shipment. Standard units, designed for 100 lb per square inch operating pressure, are available in 10 sizes with capacities from ½ to 25 boiler horsepower.

For more information, circle on Inquiry Card, **Item 23**

Wet-Base Oil Boiler

An addition has been made to its line of Pacemaker oil burning boilers by Burnham Corp., Irvington, N. Y. The new boiler has a wet-base construction with the combustion chamber completely surrounded by heating surface.



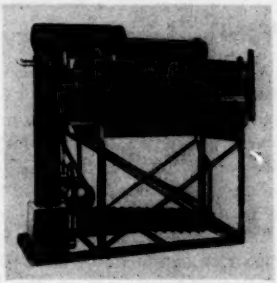
A special flange-mounted Burnham oil burner designed for the boiler is available. The boiler is in two sizes and two models, one for steam and one for hot water. The ratings are 250 and 375 square feet of steam, 500 and 680 square feet of water. The two sizes have burners with capacities of 0.90 and 1.35 gallons per hour.

Year-round domestic hot water is available from a built-in all-copper heater for tankless operation. Extended surface fins are used to increase the heating surface. Boilers are attractively styled in a two-tone tan jacket, heavily insulated. The jacket is extended to conceal the burner and all controls.

For more information circle on Inquiry Card, **Item 24**

20-Ton Absorption Water Chiller

Production of an absorption-type water chiller with a capacity of 20 tons or more, for use with air conditioning units or in manufacturing processes, is announced by Servel, Inc., Evansville, Ind. Available for defense orders only, it is designed for conditioning multi-storied buildings, and may be used in factories, offices, government buildings, and a host of other multiple-room applications connected with the defense effort.



Nominal refrigeration rating is 20 tons when it supplies chilled water at 45F, uses 360 pounds of steam per hour and 85F condensing water.

The water chiller is exceptionally compact. It is 30 inches wide and less than eight feet long, occupying 19 square feet of floor area. It can be carried into a building through a standard-width door. Units are hermetically sealed and capacity-tested at the factory. There is no field assembly of the equipment.

The new water chiller operates on the absorption refrigeration principle much like the company's three- and five-ton all-year air conditioners. In this case, however, water is refrigerated, and not air.

For more information, circle on Inquiry Card, **Item 25**

High Output Process Heaters

A line of direct-fired heaters with capacities 100,000 Btu per hour to 15,000,000 Btu per hour is announced by Struthers Wells Corp., Warren, Pa. The heaters are designed for a wide range of applications, including indirect circulating heating using heat transfer mediums, such as Dowtherm, and for direct heating of vapors and liquids. Temperatures range to 750F or above.

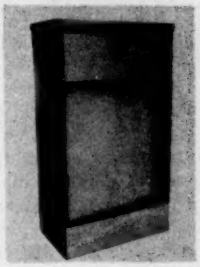
Complete automatic control systems are available which largely eliminate operating attention. Operating costs may be comparable with those for steam boilers in smaller sizes. Completely engineered systems, including all necessary equipment, are available if required.

The heaters may also be used to supplement existing boiler capacity or for installation in remote plant locations to save cost of new steam facilities. Bulletin B-45 is available.

For more information, circle on Inquiry Card, **Item 26**

Machine Tool Coolant Cooler

The Will-Cool oil cooler has been announced by B. S. Williams Co., Inc., Mt. Vernon, N. Y., for cooling and otherwise controlling the temperature of cutting oils on machine tools. The unit contains a condensing unit with a capacity ranging from 1½ to 7½ tons, depending on the size. The coolant is not exposed to the atmosphere while being cooled.



It is claimed that the temperature of coolants is a limiting factor in many production jobs because the temperature rises to the point where tool wear or failure to hold tolerances results. Consequently, additional cooling is needed.

The company claims that the cooler makes possible the following advantages: increased capacity; uniform work pieces; uniform oil viscosity; longer tool life; less tool grinding; less adjusting time on machines; cooler work pieces to handle and gage; and reduction of oil evaporation.

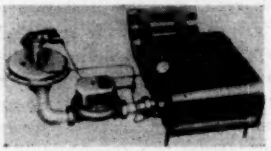
Coolants are usually not clean, and for that reason the unit is designed so that it can be inspected and cleaned without disconnecting refrigerant or oil lines.

Only the normal low head, low horsepower, open impeller pump is required to lift the oil to the top of the cooler. The oil is confined to the cooling surface in a film and flows by gravity over the surface and back to the machine tool's tank.

For more information, circle on Inquiry Card, **Item 27**

Large Capacity Gas Burner

Two new Janitrol gas conversion burners identified as Models SC 05, designed primarily for commercial and industrial installations for converting steam, hot water or warm air systems to natural or mixed gases, are introduced by Surface Combustion Corp., Toledo, Ohio. Both models are complete factory assembled packages to meet input capacities from 325,000 to 750,000 Btu per hour.



Simple installation and full accessibility are among the many features. Optional equipment to meet local requirements of gas utilities, city, underwriters and insurance companies, include instantaneous flame failure protection with complete control panel. Specifications and performance data are available from the manufacturer in Bulletin JS-162.

For more information, circle on Inquiry Card, **Item 28**

Portable Dehumidifier

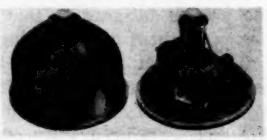
The Model R-18 air dryer has been introduced by Desomatic Products Division of Daly, Merritt and Sullivan, Inc., Falls Church, Va. This model is a plug-in type dehumidifier which can be moved with ease from room to room wherever humidity, mildew or rust is occurring.

Unit is powered by a Silent World Tecumseh hermetically sealed compressor with a permanently lubricated Redmond fan motor. The unit will dehumidify a closed area of tight construction up to about 8,000 cubic feet. Condenser is of finned copper tubing, evaporator of aluminum extended surface coil. Device, which has an air flow of 110 cfm, is 17 inches long, 13 inches wide and 15½ inches high. It weighs 55 lb and is supplied in a baked crackle green finish cabinet.

For more information, circle on Inquiry Card, **Item 29**

Thermostat for Radiant Heat

The Surface Type Thermoray comfort thermostat is announced by Sarcotherm Controls, Inc., New York, N. Y. It is designed to function on operative temperature rather than on air temperature. Operative temperature takes into account the mean radiant temperature of the enclosure area, the ambient air temperature, and air motion.



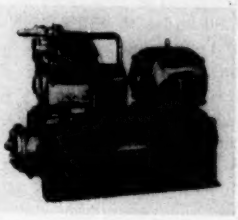
The instrument is a revision of the original type which was of globe design and which was quite efficient but was not especially attractive. The Surface Type Thermoray combines both efficiency and satisfactory appearance. It can be installed on either the wall or ceiling of the room and with hot water systems can either be arranged to depress the blended water temperature or can be directly connected to the circulating pump. It is also intended for control of electric panel heating.

The instrument can be used for line or low voltage circuits, and can be furnished with double switch action for any special control sequence required.

For more information, circle on Inquiry Card, **Item 30**

1750 R.P.M. Condensing Units

Three direct drive refrigerating compressors operating at 1,750 rpm have been added to its line by Schnacke, Inc., Evansville, Ind. Three models are offered in the line at the 1,750 rpm speed; namely, Models ATD-15, AFD-30 and AED-60, the figure representing the capacity in tons. All are available as complete condensing units.



These three models were designed for the top capacity but the same compressors are also used for other applications at slower speeds, thus enabling greater production at lower cost on the compressor bodies.

For more information, circle on Inquiry Card, **Item 31**

Water Level Safety Switch

The Autocon Hi-Level safety switch has been introduced by Automatic Control Co., St. Paul, Minn. The purpose of the switch is to provide an auxiliary high level safety switch to operate either audible or visual alarms when the water level rises in tanks, streams, or sumps.

The switch operates at a ½ inch rise in the water level. This rise compresses air in the bell chamber which operates the switch to set off the alarm so that a warning is given of unusual load conditions, danger of overflow, and other emergencies. Switch is entirely independent of other control equipment. It is a non-float, non-electrode device and not affected by low temperatures or age.

Applications include clear well or surge tanks, elevated tanks, vats, sumps and industrial processing. The pipe between the bell shown at the bottom of the illustration can be lengthened or shortened to suit its specific application.

For more information, circle on Inquiry Card, **Item 32**

PRODUCT INFORMATION SERVICE

Use the postage-free postcards below for further information on:

- **News of Equipment and Materials**
- **New Catalogs**

Circle the Item Numbers in which you are interested and print clearly your name and address with title.

NEW CATALOGS

CONDENSED CONTROLS CATALOG

A 1951-52 heating controls catalog, containing price lists, technical data, installation helps and charts and diagrams, has been published by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. Illustrations are large and a unique cross index system greatly simplifies finding proper controls for specific applications. All reading matter has been simplified, and the catalog contains sections on thermostat heater data, information on selecting control systems and helpful hints on installation procedure. .....Item 33

ELECTROSTATIC CLEANER EXPLAINED

An eight-page leaflet, SA-6691, that describes the Precipitron electronic air cleaner in non-technical language, is available from Sturtevant Div., Westinghouse Electric Corp., Boston, Mass. Air cleaning units for factories, for stores, for offices, and for homes are covered. Describes the unit and explains how it operates, why it cleans air efficiently, where it can be used to advantage, how it is constructed, and the kind of unit to select for a given job of air cleaning. .....Item 34

MERCHANDISING HELPS ON COOLING

A Package of Profits Plus Packaged Merchandising Ideas is the title of a brochure issued by the Refrigeration and Air Conditioning Division, Yates-American Machine Co., Beloit, Wisconsin, and devoted to selling ideas and selling helps for dealers handling the company's line of air conditioning equipment. .....Item 35

STORING COOLING CAPACITY

Bulletin 108, 8 pages, entitled Icy-Flo Accumulator, has been issued by McQuay, Inc., Minneapolis, Minn., and devoted to its accumulator for stored cooling capacity for air conditioning. Book is especially rich in application data, including hook-ups, capacity information, and selection. .....Item 36

CLEANER AND SEALER LINE

A 4-page folder has been issued by Parke-Hill Chemical Corp., Mt. Vernon, N. Y., and describing its Sludge-Ban, a fuel oil sludge remover; Oxi-Ban, a liquid boiler cleaner; Soot-Ban, a fast-acting soot remover; a boiler sealer for stopping leaks in steam and hot water systems; Greas-Ban, a solvent for degreasing and decarbonizing nozzles, strainers, and pumps; Dri-scale Ban, an oil absorbent and suspendent for new and oily boilers; a cesspool cleaner; Scale-Ban, a liquid boiler cleaner for rust, scale, sludge and slime; and Ban-Soil, a blotting material for oily or greasy floors. .....Item 37

CHEMICAL RESISTANT PIPE

Engineering data on tubing, pipe, valves and fittings of Ace-Saran and Ace-Parian (polyethylene) plastics are given in its 16-page bulletin, 351, just released by American Hard Rubber Co., New York, N. Y. Of particular interest are tables of properties and tables of resistance to a long list of common chemicals. The bulletin also gives bursting and working pressures, standard sizes and weights, etc., and offers helpful information on the fabrication of complete systems from these new plastics. ....Item 38

PIPING POINTERS MANUAL

A new edition of its popular Piping Pointers manual is announced by Crane Co., Chicago, Ill. The new manual covers the fundamentals of sound piping practices in easy-to-grasp, non-technical language. It discusses various types of valve designs and how each should be used. It illustrates and names more than 80 kinds of fittings. More than half of the 36-page manual is devoted to "how-to-do-it" features that are fully illustrated for easy understanding. Included with the manual is a Crane Valve Selection Guide that saves time and effort in selecting valves for common piping services. .....Item 39

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EXPANSION JOINTS

Bulletin 351, describing its complete line of expansion joints, has been published by Zallea Brothers, Wilmington, Del. It gives sizes, dimensions, suggested applications and other technical data on a variety of joints for piping from small flexible connectors to 30-foot diameter self-equalizing joints. .....Item 40

GAS BURNER GUIDE

A 10-page standard size booklet on servicing and installing gas burners has been published by The Adams Manufacturing Co., Cleveland, Ohio. Manufacturer states that being unable to obtain simple gas burner guides for his own organization, he decided to print his own and to make this available to anyone who wants them, since the information is generally applicable to all makes of equipment. They are available for fifty cents each, with discounts for larger quantities. .....Item 41

ELECTRIC RADIANT HEAT

A 4-page folder on Electriglas radiant heating, entitled Check List for Architects, Engineers, Home Builders and Electrical Contractors, has been published by Appleman Art Glass Works, Bergenfield, N. J., and devoted to the system of electric panel radiant heating manufactured by that company. .....Item 42

SMOKE CONTROLS AND ALARMS

Two single sheet bulletins have been issued by General Power Plant Corp., New York, N. Y.; one, Bulletin 110, being devoted to the company's smoke alarm for coal, oil and gas burning installations and which sounds an alarm when the smoke density is over a legal limit. The other, Bulletin 107, covers a combined smoke alarm and indicator and recorder on smoke density. .....Item 43

STEAM PLANT CONTROLS

A 12-page catalog entitled "Combustion Controls" has been issued by Cleveland Fuel Equipment Co., Cleveland, Ohio, devoted to its line of damper controls, steam controls and gages for steam boilers. Includes a description of the company's new Master Regulator, the Model SC-B steam control. .....Item 44

STEEL BOILERS

A commemorative bulletin, HV-86, which is also a condensed catalog, has been issued by Fitzgibbons Boiler Co., New York, N. Y., this being the company's 65th anniversary. The bulletin is entitled Straight Ahead Since 1886 and consists of 8 pages. Included are a history of the company. Booklet keynotes the company's contributions to the heating industry and describes briefly its line and its plant. .....Item 45

BLOWER DATA

A 6-page bulletin entitled The Standardaire Blower has been issued by The Standard Stoker Co., Inc., New York, N. Y., and giving engineering layouts, application data, design data and ratings for the company's line of blowers. Item 46

ORGANICS IN WATER TREATMENT

A new folder on the use of organics in water treatment has been issued by Power Chemicals Div., E. F. Drew & Co., Inc., New York, N. Y. This 4-page folder describes the need for organics in altering the nature of sludge in order to make it non-adherent. It covers the theoretical and practical considerations involved in the use of organics and describes and illustrates the manner in which they overcome the problems of sludge. ....Item 47

PUMP DATA

Two individual sheets for distributors' and dealers' catalogs, Forms 8150 and 8150-A, have been issued by Jabsco Pump Co., Burbank, Calif. Form 8150 is for the standard line of bronze pumps only and shows the capacity horsepower tables on the front with the price list for the pumps complete and for the principal parts on the back. Form 8150-A contains the same information on the present line of stainless steel Superior series pumps and the two cast-iron pumps. .....Item 48

VENTILATING EQUIPMENT

Publication of its 1951 catalog illustrating its complete line of ventilating equipment, including pedestal, wall and ceiling fans, attic fans, exhaust fans, and reversible window fans, is announced by Circulators & Devices, Brooklyn, N. Y. .....Item 49

AIR FILTER GAGES

A new bulletin, No. 114, describing its inclined draft gages for application to ducts at point where air filters are installed, to check air flow resistance, has been issued by Ellison Draft Gage Co., Chicago, Ill. .....Item 50

SEALED COMPRESSOR DATA

Detailed description of the 2, 3, 5, and 7½ hp hermetically sealed refrigeration compressors and condensing units is given in Bulletin DB-101-110 available from Westinghouse Electric Corp., Sturtevant Div., Hyde Park, Boston, Mass. Features of the compressors and condensing units are described in detail and illustrated liberally. Specification data are surprisingly complete. .....Item 51

Product Information Service

Use the postage-free postcards below for requesting further information on products mentioned in the following sections of this magazine:

News of Equipment and Materials • **New Catalogs**

Simply circle the numbers of the items in which you are interested. Please print your name and address.

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What Would You Do?

Replies to engineering and operating problems of interest to the industrial plant engineer

This Month's Problem

What measures have you found effective for eliminating fog in dyehouses? We have exhaust fans to draw out the fog but they only seem to make conditions worse in cold weather.

IN the box on top of this column is the industrial plant problem that is discussed in this issue. The information supplied in answer to this question by a group of chief engineers and plant engineers associated with the textile industry, should prove of value to others who are faced with a similar problem.

Do you have a problem that you would like to see treated in this department? Do you have a solution to the ones scheduled for future discussion? The Editor cordially invites such letters.

Suggested Solutions

Many schemes are used in an effort to remove fog from processing rooms containing open vats of boiling water or drying machinery that releases water vapor into the room air. Few strike at the heart of the two-fold problem.

One approach is that sufficient air must be taken out of the room to remove the water vapor at enough speed to keep the atmosphere of the room from becoming humid enough to get much above 80% R. H. at the existing temperatures. The other method is that the air brought into the room to replace that exhausted must be heated to a temperature so that it will be well above the dewpoint of the atmosphere into which it is injected. A third angle, not mentioned, is that any humid atmosphere contacting any part of the building that is below its dewpoint, will give condensation drips that are most damaging to goods stored in trunks on the floor.

From the way the question is stated, it seems that the man who has this trouble is violating a basic principle sometimes called "The Law of Guzinta and Guzouta." The questioner has some exhaust fans arranged so that air goes out of the room. Such exhaust air is replaced by air that enters through cracks around windows, open doors, broken window panes, etc. He should have an air quantity balance made, and take into consideration the heat losses through walls, ceiling and windows. From the findings, he could probably improve his condition.

Where the room volume is large and the area liberating vapor is comparatively small in comparison, hoods over the vapor-releasing areas are very advantageous. These hoods should be designed to give a good sweeping velocity around the sides of the hood to keep vapors from getting loose in the room. This is a useful device to cut down air quantity required for vapor control. Its worth depends rather strictly on the amount of thought given to the design of each individual hood so it will fit the machine with which it works and the amount of vapor released under it.

Dan McConnell, Plant Engineer,
Greensboro, N. C. *Cone Mills Corp.*

In our dyehouse we have exhaust fans to take out the vapor and dead air. We supply warm air to the rooms by passing clean air over steam-heated finned coils and we deliver this warm air through ducts to the dyehouse. Conditions are satisfactory if infiltration from open doors and windows is held to a minimum. Some difficulty is experienced during winter on days when the outside air is high in humidity.

The ideal solution is to have totally enclosed kettles with an exhaust system removing steam vapor as required, meanwhile supplying warm air to the room. Enclosing all kettles also increases the thermal efficiency of the dye kettle.

Chief Engineer
Passaic, N. J. *Textile Mill*

Problems to be Discussed

June Issue

What is the best location for a steam trap when the condensate has to be elevated to an overhead return main?

July Issue

What is a good empirical rule-of-thumb to use in figuring the hourly air change in a textile mill in the summer? This air change should be only that caused by infiltration and exfiltration around and through doors and windows and through walls of a completely unconditioned mill. What would be the effect on such air change of the increased vapor pressure inside the mill caused by mechanically introduced water vapor, as in a standard humidifier system?

The following is from the book "Air Conditioning Analysis" by William Goodman:

"Fog forms when air is cooled below its dewpoint temperature. When this occurs, the water vapor condenses on nuclei consisting of dust particles.

Fog in a dyehouse may be expected when cold air from outside comes into contact with moisture-laden air within the room. The two means of remedying the condition immediately apparent from this are: (1) raise the temperature of the outside air that enters and (2) lower the humidity of the inside atmosphere.

It is the natural and common tendency to attempt to improve conditions in a dyehouse by increasing the exhaust. Visible steam, or vapor, is seen to rise from an unhooded beck, soaper, etc. It seems logical to install a roof exhaust over it to draw the vapor from the room. A hood is observed to have clouds of vapor curling out at the periphery into the room, and it is logical to increase the air flow through the hood and the velocity across the face.

What is commonly overlooked is that the air must come from somewhere. If no adequate provision is made to introduce this air, after it is first heated, then air will be pulled in through cracks, and this air will be unheated. If the air rushes into the room when a door is opened, it shows that this condition exists.

Not only does the unheated air bring about the fog condition complained of, but the negative pressure in the room substantially decreases the capacity of the exhaust fans, thus causing more vapor to escape from hoods. A solution depends (1) on adequately hooding all sources of vapor rising from hot water surfaces, and (2) on supplying an equivalent amount of tempered air to balance the rated exhaust capacity.

Since even in winter, most dyehouses require cooling for the comfort of the occupants, as little heating of the incoming air should be done as is consistent with fog prevention. The permissible temperature of the entering air will depend on the effectiveness of the hooding and similar factors. This is difficult to predict. By controlling the temperature of the supply air through a thermostat, the temperature can be set for a point found most effective. This will probably be between 60 and 70F. If vapor sources are poorly hooded, or not at all, a higher supply temperature may have to be used, as determined by trial. Precautions against freezing of the coils must, of course, be taken, either by using a preheating coil or by keeping steam on the coils, and modulating face and by-pass dampers.

Other problems common to dyehouses are providing reasonable comfort for the occupants and prevention of roof condensation.

Chief Engineer
New York, N. Y. *Testing Laboratories*

Temperature and humidity of air in the room, or the air entering the room must be correct. If air or surfaces in the room get too cool, moist air striking them will lose moisture in the form of condensate or fog. If cold air enters the room and meets with warm moist air, fog results. The remedy is to keep the room heated during week ends and to arrange to have the air supplied from a warm adjacent room. Fans aggravate matters because when warm air is exhausted at a rapid rate, it increases the amount of cold air that enters the room.

Walpole, Mass. *Plant Engineer*

Fuel Oil Burner Outlook for 1951

Oil burner sales have increased rapidly in recent years, according to Carl R. Jonswold, executive vice president, Arrow Petroleum Co., in a talk given before the Oil-Heat Institute of America, at its Chicago convention. He reported:

"In 1945 there were over 2,500,000 domestic power burners in use. By 1950 this figure had more than doubled. Final figures will probably indicate about 5,200,000 units as of December 31, 1950. Sales for 1950 produced an increase of over 14%. The burner market faces gas competition and what is more important, an uncertainty of material supplies and a restricted building program. Copper restrictions could cut sales by 20%. For January and February of 1951, sales are up about 20 to 25%, but this is the low ebb of the year. Will the materials be there when the demand develops later in the year? This is a question which no one can answer but many manufacturers are laying plans to proceed full speed ahead. Others feel that their production may be hampered by war contracts. In spite of restrictions, credit limitations and material shortages, the National Association of Home Builders predicts that more homes will be built in 1951 than in any other year with the exception of 1949 and 1950, which were record years. We can be sure that there is still a great market for our products. My prediction would be for a net gain of 525,000 oil heat users in 1951, after taking into consideration replacement sales and oil heating users lost to competitive fuels. The industry lost 68,000 customers to competitive fuels and sold 94,000 units for replacements last year. This will increase demand for fuels from this class of users by about 10%.

"There were approximately 2,500,000 space heaters in operation prior to January 1, 1946. From that time to December 31, 1950, the industry has sold 3,862,000 space heaters, 334,000 water heaters, 315,000 floor furnaces and 150,000 central heating plants, for a total of 4,661,000 units. No one knows the life of one of these units but it is safe to say that not over 10 to 15% of the original 2,500,00 can be considered as replacements in any one year. For 1950 the industry probably sold at the retail level about 860,000 units of all kinds. We should assume that this produced 500,000 new oil users, or a gain of 7%.

"It seems reasonable to expect that industrial and commercial equipment, which includes conversion burners and packaged steam generators, will produce about 35,000 to 40,000 new users in 1951. This will increase the fuel oil demand about 8%."

PRODUCT APPLICATIONS

New, Unusual, or Ingenious Uses of Equipment and Materials

Largest Supply Plenum is Acoustically Treated

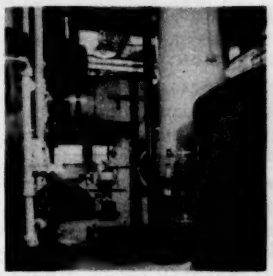
PROBLEM: In the building of the California Packing Corporation in San Francisco, an air supply plenum 57 ft tall by 28 ft wide and 6.5 ft deep was required to be sound conditioned.

SOLUTION: Ultralite duct liner was applied on three sides with both an adhesive and Type N Stick-Clips. Lining is one inch thick and weighs three lb per cubic foot. Ultralite duct liner is a long, fine, fire resistant, glass fiber insulation. The fourth wall of the cone consists of louvered openings through which air is drawn at each of the five stories in the building.

RESULTS: The insulation and sound absorbing qualities of the plenum lining assure economically quiet operation.

Solvent Recovered with Activated Carbon

PROBLEM: A new solvent recovery plant, The Garlock Packing Co., Palmyra, N. Y., was to be equipped to collect about 1,000 lb of gasoline per hour from the air and deliver it ready for reuse. The gasoline is vaporized during the manufacture of asbestos sheet packing. The company uses a medium boiling range gasoline in preparing a mix which is rolled through sheeters or presses to produce the finished product. For about 30 years they faced the problem of disposing of the solvent vapors safely, and, if possible, reclaiming some of the gasoline. A condensation system proved unsatisfactory. The oil absorption system, when new, recovered 50 to 60% of the vapors but the efficiency fell off to 25% because of reduced inlet solvent concentrations, increased operating temperatures, greater loads, and general deterioration of equipment.



SOLUTION: Garlock called in experts of Carbide and Carbon Chemicals. A pilot plant test with a Columbia activated carbon system proved successful and a completely automatic plant was built. Special hoods and ducts were designed to meet conditions at the sheeters so that concentration of solvent in the exhaust air could be kept within safe limits. The air from all sheeter hoods is delivered through a 36-inch duct to the recovery building. Operation of the entire cycle is fully automatic. Beds are composed of small hard pellets of a special type of activated carbon made expressly for solvent recovery purposes. A cubic inch of these pellets has an active surface area of 132,000 square feet. Vapor-laden air is first passed through a renewable, glass fiber filter to remove asbestos fibers, sulfur, talc dust, and other materials. After passing through a finned tube cooling unit, the filtered vapor-laden air is ready for its passage through the carbon beds. When the carbon bed is saturated (in about 60 minutes) the intake air is automatically switched to another adsorber. There are three adsorber vessels operating in the plant. Low pressure steam is sent through the saturated carbon bed to drive out the adsorbed solvent and the steam and vapor mixture goes to condensing and separation equipment.

RESULTS: The new plant established a recovery efficiency of 99.24%. Operating records for a ten-month period show an over-all monthly efficiency of 95.9%.

Curtain Cuts Cooling Load One-Third

PROBLEM: Load calculations for a 14-alley section of the Lucky Strike Bowladrome in Boston showed a 15-ton cooling requirement for a 15 degree temperature drop. The equipment to carry this load appeared excessively expensive.

SOLUTION: A saving of one-third in the cooling requirement was effected by hanging a 4-foot Plexiglass curtain from the ceiling between the public area and the alley area. The curtain extends the full width of the alleys at the foul line and obstructs the flow of cold air over the alleys. The contractor was able to guarantee design conditions with a 10-ton U. S. Air Conditioning Kooler-aire packaged unit. Ducts above the ceiling carry the cool air to six diffusers spaced at ten-foot intervals, four feet in front of the Plexiglass curtain.

RESULTS: Owner Joseph Bonigli, former champion bowler, is so satisfied with the operation of the system that he has ordered a 7½-ton unit to cool the other section of the establishment containing ten alleys.

Clay Pipe Ducts Heat Garage

PROBLEM: In a recently completed building that houses the garage, showroom and office facilities of Spot Motor Co., Akron automobile dealer, a total of 25,000 sq ft of solid floor space was required to be heated with warm air without using critical metal for ducts.

SOLUTION: A total of 250 ft of extra-strength clay pipe and fittings, manufactured by The Robinson Clay Product Co., was laid under the poured concrete floor to serve as duct work for a warm air heating system. The main duct system starts with 24-inch pipe at the furnace, reducing to 12-inch pipe at the farthest perimeter points. From the main ducts, branches of 8-inch clay pipe connect with 17 registers located in the floor at the base of the showroom windows. Heat is supplied by two forced air gas-fired blower units with a combined output of 250,000 Btu per hour.

Trench depths for the heating system vary from 42 to 24 inches. The vitrified clay pipe was cradled in sand and backfill tamped to a height of six inches over the top of the pipe. All joints were made with hemp packing and mortar. Wire mesh reinforcing was laid over the backfill and floor masonry was poured to a depth of six inches.

Another important feature of the new building is a vitrified clay pipe system of monoxide vents connecting lifts, pits and repair stations to outlets in the roof.

RESULTS: The heating system and monoxide exhaust system were installed without use of critical metal ducts. Concrete floor slab was poured without special provisions to prevent buckling of underlying duct work.

Stoker Burns Surplus Wood Refuse

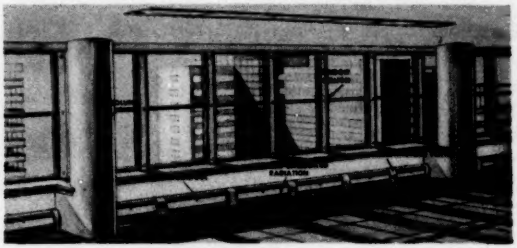
PROBLEM: At the High Point Laundry, High Point, North Carolina, a standard 200 hp boiler was hand-fired with coal and wood refuse. Excessive handling of wood refuse raised objections from boiler operators.

SOLUTION: With a surplus of wood waste available from nearby woodworking industries, the the company installed a Fyr-Feeder automatic multi-burner combustion system manufactured by the American Coal Burner Co., and especially designed to handle sawdust and wood chips.

RESULTS: The manager of the laundry reports savings of more than three thousand dollars in the first six months of operation. In addition, steam pressure has been held constant, with a consequent speeding of production.

Baseboards Heat Continuous Window Structure

PROBLEM: To maintain modern appearance and functional design in the nearly completed American-Marietta Building in Chicago, continuous windows on each of the eight floors have produced the problem of heating the building without using limited floor space.

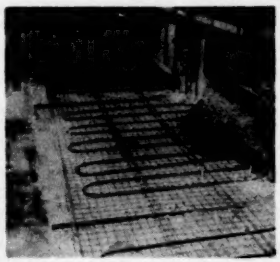


SOLUTION: Dunham baseboard radiation is located along the windowed walls. It is sectioned at the vertical window spacers and support columns to facilitate office partitioning plans. Each baseboard section contains a heating element and damper assembly. The damper permits individual room heat control. Steam will be used as the heating medium, with Dunham vacuum pumps, traps and valves.

RESULTS: Flexibility and adaptability of baseboard radiation and low pressure steam heating in multi-story buildings will be demonstrated. Heat will be introduced under long windows without use of floor space.

Embedded Pipe Solves Sticky Refinery Problem

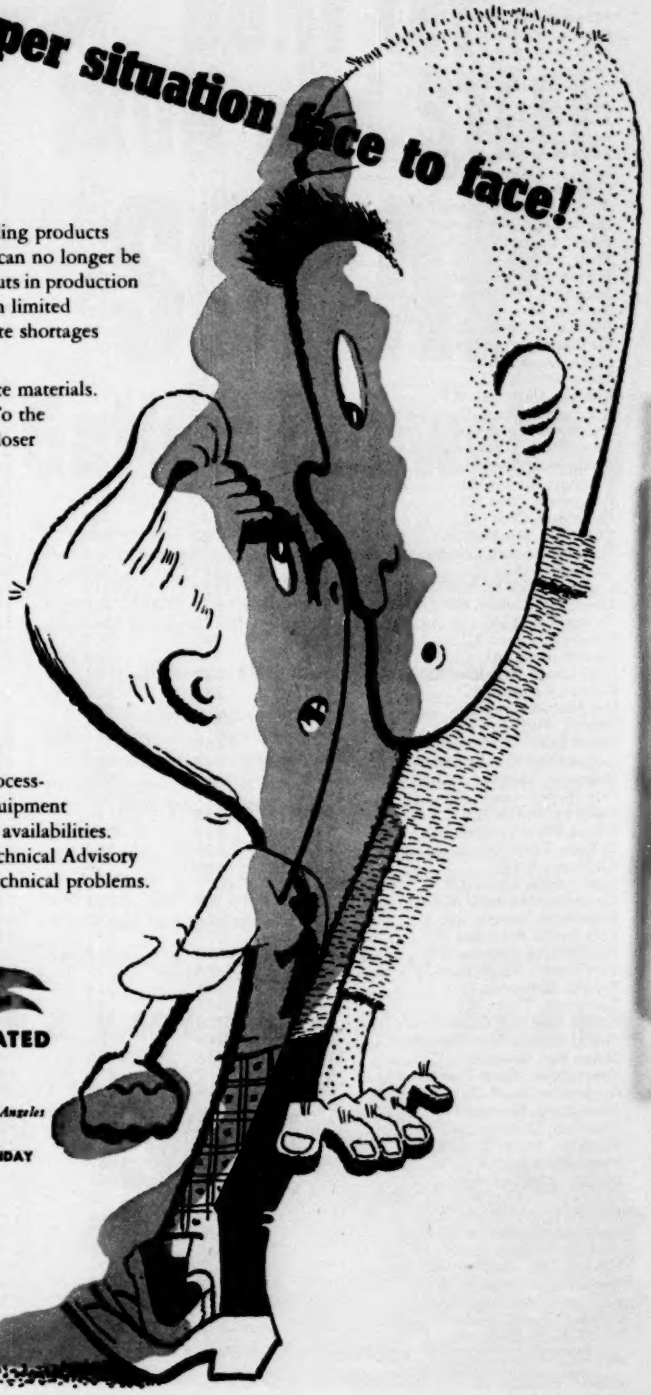
PROBLEM: A southern sugar refinery had been plagued by the presence of moisture on the floors of a raw sugar warehouse at a deep water port where relative humidities ranged quite high. Floors consisted of concrete covered with quarter-inch steel plate. Cold weather sweating, particularly after a warm humid night, created a hazard because of the inevitable spilling of sugar. The small particles stuck to the damp floor, making the area dangerous to work in.



SOLUTION: The entire floor was ripped up and radiant heating coils of 1-inch wrought iron pipe were installed with a new floor laid over them. This system was expanded also to cover all runways from the wharf to the manufacturing area. The installation is regulated to keep the floor slab at a temperature 5 to 8 degrees warmer than outside temperature.

RESULTS: Condensation moisture has been eliminated. Recently the entire refined sugar shipping department got a similar treatment, including storage, operational, and shipping areas.

let's meet the copper situation face to face!



● In the months ahead there will be some building products formerly made of copper and copper alloys that can no longer be made of these materials. Others, due to required cuts in production and D.O. rated orders getting first call, will be in limited supply. Further complications arise from the acute shortages of raw materials.

In some cases you will be forced to use substitute materials. But that doesn't mean we must part company. To the contrary, the present situation should bring us closer together. Because you're going to have more problems than ever, we may be able to help you through Revere's Technical Advisory Service.

This Service is backed by a wealth of knowledge accumulated over a century and a half of working with metals. Why not put that knowledge to work for you? Revere would like to collaborate with you regarding the usage, to their best advantage, of the products you *can* get.

And don't forget, while supplies are limited, you can still use Revere Copper Water Tube in domestic hot and cold water lines, industrial processing lines, underground service lines, and gas equipment piping. Check with your Revere Distributor for availabilities. He will also put you in touch with Revere's Technical Advisory Service in the event you wish to discuss your technical problems.

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DEGREE-DAYS FOR MARCH, 1951

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING'S 23rd Year of Publication of Monthly Degree-Day Data

City	March			Cumulative, September 1 to March 31			Heating Season[1]
	1951	1950	Normal	1950-51	1949-50	Normal	Normal
Abilene, Texas (A)	297	310	273	2350	2061	2034	2061
Albany, New York (A)	.....	1166	980	.....	5939	5848	6580
Albuquerque, New Mexico (A)	572	522	527	3384	3607	3970	4298
Alpena, Michigan (C)	1107	1287	1213	6548	6488	6873	8299*
Anaconda, Montana (C)	(a)	1150	1081	(a)	6904	6737	8357**
Asheville, North Carolina (C)	538	652	555	3784	3175	3831	4232
Atlanta, Georgia (C)	373	460	388	2229	2778	2758	2890
Atlantic City, New Jersey (C)	698	816	806	3873	3656	4437	5176
Augusta, Georgia (A)	291	387	273	2492	1698	2137	2161
Baker, Oregon (C)	989	902	880	5515	5927	5904	7163
Baltimore, Maryland (C)	611	735	701	3765	3423	4163	4533
Billings, Montana (A)	1313	1072	955	6444	6554	6209	7119
Binghamton, New York (C)	909	1097	995	5431	5389	5960	6808
Birmingham, Alabama (A)	326	414	260	2681	2028	2283	2352
Bismarck, North Dakota (A)	1680	1353	1283	8770	8691	8152	9192
Block Island, Rhode Island (A)	813	939	911	4270	4253	4678	5788
Boise, Idaho (A)	860	775	651	4699	5154	4881	5552
Boston, Massachusetts (A)	797	961	908	4438	4727	5230	6045
Bozeman, Montana (C)	(a)	1098	1096	(a)	6736	6993	8521**
Buffalo, New York (A)	917	1133	1032	5510	5449	5800	6822
Burlington, Iowa (A)	1019	948	(a)	5974	5363	(a)	(a)
Burlington, Vermont (A)	1000	1280	1088	6219	6523	6584	7514
Butte, Montana (C)	(a)	1168	1048	(a)	7154	6683	8235**
Cairo, Illinois (C)	549	614	539	3769	3188	3708	3909
Canton, New York (C)	(a)	1299	1160	(a)	6715	7002	8020
Charleston, South Carolina (C)	232	297	242	1973	1266	1733	1769
Charlotte ,North Carolina (C)	395	509	428	2942	2457	2961	3120
Chattanooga, Tennesee (A)	408	510	415	3141	2622	2974	3118
Cheyenne, Wyoming (A)	1103	1035	995	5890	5804	6174	7466
Chicago, Illinois (C)	907	965	845	5451	4979	5246	6077
Cincinnati, Ohio (C)	665	732	676	4310	3660	4351	4684
Cleveland, Ohio (A)	828	986	930	5266	4925	5371	6155
Columbia, Missouri (A)	812	762	694	4735	4183	4597	4922
Columbia, South Carolina (C)	296	413	301	2410	1886	2301	2364
Columbus, Ohio (C)	734	849	778	4869	4312	4891	5398
Concord, New Hampshire (A)	971	1157	1011	5810	6311	6332	7353
Concordia, Kansas (C)	893	824	735	4912	4752	4908	5315
Dallas, Texas (A)	260	320	267	2178	1944	2247	2256
Davenport, Iowa (C)	1011	980	893	5937	5383	5718	6289
Dayton, Ohio (A)	816	895	744	5324	4682	4787	5264
Deer Lodge, Montana (C)	(a)	1082	1056	(a)	6946	7125	8672**
Denver, Colorado (C)	898	787	800	4922	4382	5073	5874
Des Moines, Iowa (A)	1122	1001	890	6188	5698	5825	6384
Detroit, Michigan (A)	878	1070	973	5521	5364	5691	6490
Devils Lake, North Dakota (C)	1641	1469	1323	9296	9389	8694	9970
Dodge City, Kansas (A)	808	744	688	4521	4293	4646	5035
Dubuque, Iowa (C)	1168	1069	958	6545	5942	6152	6790
Duluth, Minnesota (C)	1401	1427	1265	8350	8129	7945	9483
Eastport, Maine (C)	990	1165	1110	5707	6146	6612	8520**
Elkins, West Virginia (A)	779	914	763	5107	4606	5019	5697
El Paso, Texas (A)	322	221	282	2215	2094	2383	2428
Ely, Nevada (A)	1008	960	(a)	5595	6089	(a)	(a)
Erie, Pennsylvania (C)	843	1041	973	5087	4845	5407	6273
Escanaba, Michigan (C)	1189	1309	1262	7140	7072	7290	8771
Evansville, Indiana (A)	700	706	620	4494	3759	3968	4244
Fort Smith, Arkansas (A)	454	507	397	3217	2889	3054	3147
Fort Wayne, Indiana (A)	874	1003	818	5695	5236	5321	5925
Fort Worth, Texas (A)	276	305	217	2211	1986	2121	2148
Fresno, California (A)	348	354	316	2052	2434	2199	2334
Galveston, Texas (C)	118	137	78	1080	623	1016	1016
Grand Junction, Colorado (A)	739	728	672	4719	5058	5046	5548
Grand Rapids, Michigan (A)	957	1073	964	5901	5448	5827	6535
Green Bay, Wisconsin (C)	1184	1256	1125	7432	7055	6903	7825
Greensboro, North Carolina (A)	519	612	474	3621	3141	3319	3529
Greenville, South Carolina (A)	410	519	446	3039	2605	3185	3380
Harrisburg, Pennsylvania (A)	742	892	803	4700	4461	4880	5375
Hartford, Connecticut (A)	801	998	887	4882	5142	5303	6036
Hatteras, North Carolina (C)	416	382	465	2369	1631	2316	2571
Havre, Montana (C)	1498	1256	1169	7758	8172	7557	8700
Helena, Montana (A)	1356	1066	1004	7204	7257	6615	7894**
Houston, Texas (C)	119	167	65	1167	814	1157	1157
Huron, South Dakota (A)	1415	1258	1092	7410	7409	7167	8004
Indianapolis, Indiana (A)	837	869	384	5310	4609	4855	5298
Jackson, Mississippi (A)	242	334	(a)	2155	1574	(a)	(a)
Kansas City, Missouri (A)	803	767	691	4625	4262	4644	4956
Knoxville, Tennessee (A)	471	539	496	3419	2827	3460	3670
La Crosse, Wisconsin (A)	1237	1225	1033	7308	7023	6611	7322
Lander, Wyoming (A)	1082	1015	1028	6306	6444	6694	7947

(a) Data not available.

[1]Figures in this column are normal totals for a complete heating season, September to June, inclusive.

Figures in this table, with seven exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table concluded on page 126]

Don't Let IRON and STEEL SCRAP Gather Cobwebs!

Somewhere, back in a corner of your plant or shop, there's some scrap iron and steel. Maybe quite a pile, gathering rust. Maybe some obsolete machinery, long unused. Maybe odds and ends that total many tons. You've meant to have it hauled away, but somehow it's still around.

Now's the time to sell it!

Call the nearest scrap dealer; ask him to give you a price. He'll pay good money for it. Prices are high . . . the nation's steel plants need scrap badly. With a stepped-up defense program under way, scrap is more than ever a vital ingredient of steel production. Industry must help take up the slack—*fast*.

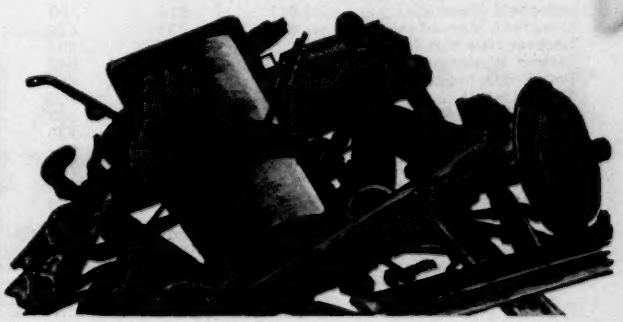
A constant flow of scrap means greater tonnages of iron and steel. It means more finished products made of iron and steel. You can help . . . and help yourself as well. Get that scrap in circulation. Get it on the job!

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

BETHLEHEM STEEL

BETHLEHEM STEEL

If you don't know the name of a scrap dealer, look one up in the yellow classified pages of the telephone directory. You'll find a listing there.



Degree-Days for March, 1951 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

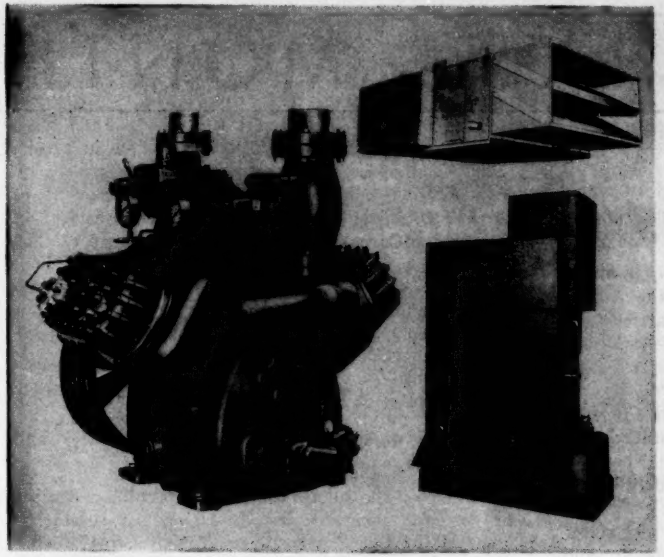
HEATING AND VENTILATING's 23rd Year of Publication of Monthly Degree-Day Data

City	March			Cumulative, September 1 to March 31			Heating Season[1]
	1951	1950	Normal	1950-51	1949-50	Normal	Normal
Lansing, Michigan (A)	960	1131	1035	6043	5862	6237	7048
Lewiston, Maine (O)	971	1133	1093	5832	6250	6625	7707
Lincoln, Nebraska (C)	991	912	840	5487	5317	5483	5999
Little Rock, Arkansas (A)	392	468	353	2952	2525	2733	2811
Livingston, Montana (C)	(a)	1015	967	(a)	6064	5985	7245**
Los Angeles, California (C)	168	198	239	921	1283	1255	1504
Louisville, Kentucky (A)	674	691	589	4320	3573	3916	4180
Lynchburg, Virginia (A)	600	682	564	3915	3419	3707	3980
Macon, Georgia (A)	254	359	260	2214	1633	2168	2201
Madison, Wisconsin (C)	1137	1160	1054	6752	6302	6611	7429
Marquette, Michigan (C)	1213	1310	1249	7056	7048	7164	8693*
Memphis, Tennessee (A)	400	500	384	3106	2599	2854	2950
Meridian, Mississippi (A)	249	365	245	2286	1704	2136	2160
Milwaukee, Wisconsin (A)	(a)	1107	1023	(a)	5975	6208	7245
Minneapolis, Minnesota (A)	1353	1264	1094	7599	7227	7044	7850
Montgomery, Alabama (A)	244	323	208	2170	1403	1884	1884
Nantucket, Massachusetts (A)	808	968	899	4384	4508	4811	5957
Nashville, Tennessee (A)	483	557	477	3602	2990	3327	3507
New Haven, Connecticut (A)	794	944	899	4681	4783	5129	5895
New Orleans, Louisiana (C)	130	180	59	1177	720	1024	1024
New York, N. Y. (C)	721	860	771	4092	3945	4608	5274***
Nome, Alaska† (A)	1656	1915	1660	11650	8136	8886	14580**
Norfolk, Virginia (C)	494	534	521	2893	2391	3104	3350
North Head, Washington (C)	720	652	623	3733	3936	3755	5452**
North Platte, Nebraska (A)	1028	996	875	5608	5691	5681	6366
Oakland, California (A)	360	389	363	1893	2516	2392	3143**
Oklahoma City, Oklahoma (C)	507	489	465	3280	3069	3451	3613
Omaha, Nebraska (A)	1055	950	868	5850	5587	5633	6131
Oswego, New York (C)	916	1153	1060	5567	5581	5993	7088
Parkersburg, W. Virginia (C)	647	788	670	4387	3909	4371	4775
Peoria, Illinois (A)	931	936	862	5760	5203	5535	6109
Philadelphia, Pennsylvania (C)	667	788	685	3953	3737	4227	4737***
Phoenix, Arizona (C)	129	90	152	969	1110	1405	1405
Pittsburgh, Pennslyvania (C)	713	872	787	4698	4196	4734	5235
Pocatello, Idaho (A)	980	885	843	5543	5851	5696	6655
Portland, Maine (A)	976	1192	1017	5833	6270	6105	7218
Portland, Oregon (C)	669	576	558	3453	3867	3732	4469
Providence, Rhode Island (C)	758	948	890	4356	4653	5206	6015
Pueblo, Colorado (A)	830	734	732	4758	4406	4872	5514
Raleigh, North Carolina (C)	436	506	446	2994	2447	3051	3234
Rapid City, South Dakota (A)	1245	1231	1010	6328	6581	6150	7118
Reading, Pennsylvania (C)	711	857	794	4364	4201	4876	5389
Red Bluff, California (A)	332	398	(a)	2294	2603	(a)	(a)
Reno, Nevada (A)	818	794	753	4538	4949	4902	5892
Richmond, Virginia (C)	543	606	543	3434	2937	3449	3695
Rochester, New York (A)	908	1148	1029	5611	5630	5854	6732
Roseburg, Oregon (C)	(a)	(a)	546	(a)	(a)	3636	4428
Roswell, New Mexico (A)	466	412	428	3071	2930	3304	3484
Sacramento, California (C)	326	350	357	2034	2381	2393	2653
St. Joseph, Missouri (A)	893	828	682	5109	4820	4803	5161
St. Louis, Missouri (C)	741	728	657	4506	3794	4309	4585
Salt Lake City, Utah (A)	861	741	722	4717	5009	4866	5555
San Antonio, Texas (A)	148	189	74	1511	1104	1202	1202
San Diego, California (A)	191	207	251	1020	1314	1350	1645
Sandusky, Ohio (C)	811	953	915	5135	4690	5299	6208
San Francisco, California (C)	330	361	353	1818	2207	2123	3264**
Sault Ste. Marie, Michigan (A)	1207	1427	1314	7441	7622	7629	9285**
Savannah, Georgia (A)	223	278	167	1965	1195	1490	1490
Scranton, Pennsylvania (C)	835	998	893	5059	5008	5445	6129
Seattle, Washington (C)	686	619	619	3596	4012	3917	4934**
Sheridan, Wyoming (A)	1211	1122	1048	6407	6775	6837	8008
Shreveport, Louisiana (A)	246	311	202	2128	1679	1938	1938
Sioux City, Iowa (A)	1197	1095	967	6468	6383	6245	6898
Spokane, Washington (A)	944	901	778	5551	6283	5485	6355
Springfield, Illinois (C)	841	826	760	5132	4446	4951	5373
Springfield, Missouri (A)	687	731	626	4328	3979	4149	4428
Syracuse, New York (A)	921	1166	1004	5719	5657	5984	6893
Tacoma, Washington (C)	740	655	648	3878	4242	4086	5181**
Terre Haute, Indiana (A)	814	835	663	5209	4473	4539	4872
Toledo, Ohio (A)	877	1031	905	5614	5245	5372	6077
Topeka, Kansas (C)	827	763	682	4619	4391	4635	4969
Trenton, New Jersey (C)	715	856	735	4288	4155	4450	4933
Utica, New York (O)	961	1215	989	5516	5892	5955	6796
Valentine, Nebraska (C)	1236	1170	980	6291	6409	6205	7039
Walla Walla, Washington (C)	694	534	598	4110	4784	4774	4808
Washington, D. C. (C)	598	717	694	3728	3353	4253	4626
Wichita, Kansas (A)	772	704	684	4275	4043	4421	4673
Williston, North Dakota (C)	1680	1400	1280	8679	8785	8238	9323
Winnemucca, Nevada (C)	894	837	767	4897	5359	5411	6427**
Yakima, Washington (A)	834	750	620	5755	5654	5053	5599

(a) Data not available.
†Nome data are for February.

*Includes August.
**Includes July and August.
***New 48-year normal covering 1898 to 1946.

[1]Figures in this column are normal totals for a complete heating season, September to June, inclusive.



Who Makes a COMPLETE Freon Reciprocating System?

A completely integrated and balanced system—all *manufactured*, not just assembled, by the *one* manufacturer—that's Worthington.

No other company makes a wider variety of complete Freon reciprocating systems.

No other company offers more perfectly balanced operation of inter-related components—for lowest costs, longest life.

Worthington Freon-12 Compressors and Refrigeration Units. One basic compressor design covers a size range from 2 to 125 tons, with three cylinder sizes. Simplified construction. Lightweight automotive pistons. Worthington Feather* Valves—simplest, lightest, quietest ever made. Internal manifold. Renewable cylinder liners and leakproof, continually-cleanable force-feed lubrication in larger sizes. Positive manual or automatic capacity control. Available in self-contained compressor-condenser units.

Worthington Air-Handling Units. Perform complete air conditioning functions. Water cooling or direct expansion. Five sizes: 4 to 60 tons, 4000 to 13,500 cfm. Horizontal or vertical. Sectional design.

Worthington Evaporative Condensers. All parts exposed to moisture made of zinc-coated steel, bonderized and coated with rubber-base enamel containing special rust inhibitor. Prime surface—no fins to clog. Staggered coils permit air deflection and complete wetting. Six sizes from 2000 to 27,000 cfm.

Also: *Worthington Evaporative Coolers* in same range.

*Reg. U. S. Pat. Off.

Bulletins containing complete information are available

First Completely Air-Conditioned Apartment House in New England

Beacon Towers Apartments, Brookline, Mass. is the first building of its type in New England to be 100% air-conditioned.

E. A. Berman Company of Boston, under the direction of M. L. Cail, installed a three-zone cooling water system for the 34 apartments. Individual room units are served by a refrigeration unit consisting of a Worthington Freon-12 compressor, evaporative condenser and water chiller.

The system is designed and operated for automatic heating in winter and cooling in summer.

Experience of the owners has been that the air conditioning helped to lease the apartments for 3-year periods.

Laboratory Air Conditioning Duplicates Mill Conditions

Worthington also manufactures a complete line of *centrifugal* refrigeration.

When the W. Harrison Hightower Textile Engineering Building was built at the Georgia Institute of Technology, Atlanta, to house its textile school, Worthington refrigeration for air conditioning was installed to provide the proper temperature and relative humidity required for textile processing.

Fourteen separate rooms are individually air-conditioned, through a chilled water system, from a 150-ton Worthington centrifugal refrigeration system, electrically-driven. This machine is equipped to shut off automatically in the event of trouble anywhere in the system.

Installed by Engineering Contractors, Atlanta, Ga.

WORTHINGTON

AIR CONDITIONING AND REFRIGERATION

INVESTIGATE

MORE WORTH WITH WORTHINGTON

Consult Classified Telephone Directory for nearest Worthington distributor. Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, N. J., specialists in air conditioning and refrigeration for more than 50 years. A-1.1

NEWS OF THE MONTH

NEW FILTER CO.

organized by Carrier and A. D. Little to manufacture filter developed for Atomic Energy Commission.

Formation of a new jointly owned company to manufacture a unique air filter, first used by the Atomic Energy Commission to keep radioactive particles out of the atmosphere, has been announced by Arthur D. Little, Inc., of Cambridge, Mass., and Carrier Corporation of Syracuse, N. Y.

The new company, known as Cambridge Corporation, is headquartered in Syracuse, and initial production of the new filter is now under way. The filter was developed by Arthur L. Little, Inc., widely known research and development engineers.

• **CAPACITIES.**—Cloud Wampler, president of Carrier Corporation, manufacturer of air conditioning and refrigeration equipment, and Earl P. Stevenson, president of Arthur D. Little, Inc., reported in a joint

R. Stevens

D. H. Northrup

statement that single filter units can be built to handle 1,000 cubic feet of air per minute at pressures within the capacities of central station air conditioning systems. They added that extensive interest had been shown both by government agencies, civil defense groups and various industrial organizations.

• **PERFORMANCE.**—The new filter will be particularly useful wherever air must be completely dust-free or sterile, as in the manufacture and assembly of precision devices, or in hospitals, biological laboratories and pharmaceutical plants.

In tests conducted in connection with atomic energy developments, it was shown that as many as 20,000 particles of various kinds might be present in a single cubic inch of ordinary atmosphere. Conventional air cleaning devices reduced this number to between 1,000 to 3,000. The new filter, however, passed on average only a single particle.

• **MEDIUM.**—The filtering medium itself is a special, soft, felt-like paper containing sub-microscopic asbestos fibers which direct the air through such tortuous paths that essentially all of the particles become entangled in the fibers. Large sheets of this paper are folded in accordion fashion and fitted into a frame, thereby providing a large filtering surface in a relatively small space.

• **OFFICERS.**—Raymond Stevens, vice president of Arthur D. Little, Inc., has been elected president of Cambridge Corporation. David H. Northrup of Carrier Corporation is vice president and general manager. Its Board of Directors is made up of representatives of the two owning companies. Offices of the new corporation are located at 350 S. Geddes St., Syracuse.

COOLING ATOM PILE

poses gigantic problems in heat transfer and air movement.

To remove the 30,000 kilowatts (1.02 billion Btu per hr) of heat generated within the nuclear reactor or heat pile at Brookhaven National Laboratory during the fission process, an extensive cooling system was required. In the fan house adjacent to the reactor building, centrifugal compressors draw 300,000 cfm of air through the pile cooling system. Air speeds vary from 40 miles per hour in the main ducts, two of which are large enough to accommodate a New York subway train, to hundreds of miles per hour in the small graphite passageways. The five blowers are each driven by a 1,500 horsepower motor at a speed of 3,600 rpm.

The method followed in the design of the fans is typical of the procedure carried out by H. K. Ferguson Co. engineers in other phases of the project, such as instrumentation. Every effort was made to adapt existing industrial equipment to the requirements at Brookhaven. In this manner, conventional items of equipment with modifications could be utilized, and the background of experience in manufacturing and operating this equipment could be put to use. The alternative of designing special equipment was avoided wherever possible, and additional costs eliminated.

In the case of the fans, B. F. Sturtevant Division of Westinghouse Electric Corporation worked closely with Ferguson to adapt one of their models. This fan installation is one of the largest in which such a high pressure ratio is achieved in a one-stage installation of air coolers on the suction side of the fans to reduce the temperature and volume of air, with a resulting reduction in equipment size.

Air is filtered before and after it leaves the pile. Dust is taken out before air goes into the pile, and any dust which may have been picked up inside the pile is removed before it is expelled. The air is finally exhausted through a 320-ft reinforced concrete stack tapering from 32-ft in diameter at the base to 19-ft at the top. A silencer of unique design was built into the ducts and the base of the stack to eliminate noise which would be disturbing in a laboratory setting. Alphons Custodis Chimney Construction Company built the stack.

A secondary cooling system was also installed. It was necessary because temperatures of exhaust gases

Airsan Air Filter Protection Means Effective Dust Collection

Airsan expanded metal face plate acts as a lint arrestor to provide easier cleaning and servicing and distributes air evenly over entire filtering area, providing high filtering efficiency and dust holding capacity with low resistance. Other features include all galvanized construction and full bronze welded corners.

Airsan Air Filters available in standard 1" and 2" thickness with filters for industrial and special applications in 2" and 4" thickness.

Holding frames (for V type or straight banks) are made for all type filters.

* FORMERLY AIRCOR

Air Filter Corporation

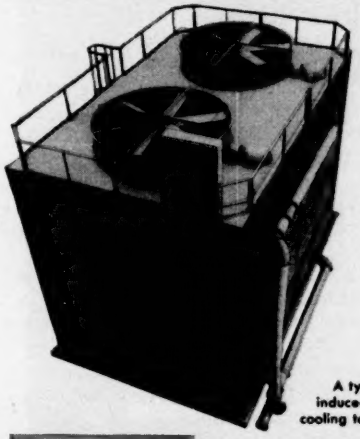
108 H NORTH WATER ST. • MILWAUKEE, WIS.

Canadian Representative

DOUGLAS ENGINEERING CO., LTD., MONTREAL

A Few Distributorships Available. Write for Details.

LOW COST WATER COOLING!



A typical Binks Type K induced draft cooling tower.

Binks mechanical draft cooling towers operate efficiently in close quarters

Every Binks cooling tower is designed to give you the correct air-to-water ratio for maximum cooling efficiency. Because Binks mechanical draft towers create their own air movement, they are ideal for difficult locations. Towers of this type are made by Binks with capacities from 3 to 1000 tons of refrigeration...a standard size and type for nearly every need, without the expense of special engineering. Binks towers are ruggedly built to provide long-life and low maintenance.

- Rigid steel frame, steel encased.
- Fans up to 144" diameter of corrosion resistant alloy. Variable pitch blades.
- Spray-filled or deck-filled construction.
- Easy to erect. Parts all shop fabricated.

Clog-proof Rotojet nozzles used exclusively in Binks towers are designed on the off-center inlet, whirl chamber principle. They assure maximum fluid break-up . . . maximum heat dispersal.

Send today for the following Bulletins:

- No. 33—Type 2-D horizontal single fan towers. To 90 GPM
- No. 34—Type 2-D horizontal twin fan units. To 300 GPM
- No. 36—Type 2K-S spray-filled cooling towers. To 660 GPM
- No. 37—Type 2K-W wood-filled towers. To 525 GPM
- No. 39—Type K heavy duty towers. To 3000 GPM
- Nos. 46 & 47—Types 2-S and 2-SS towers. To 180 GPM

THERE'S A BINKS TOWER FOR EVERY COOLING JOB

Binks MANUFACTURING COMPANY

REPRESENTATIVES IN ALL PRINCIPAL CITIES ■ 3120-38 CARROLL AVENUE, CHICAGO, ILL.

from the pile are higher than temperatures concrete can stand continuously. The secondary cooling system was therefore developed to prevent impairment of strength and life of concrete in the duct system.

Refrigeration was required for air conditioning the pile building and control areas, the pile laboratory and an adjacent "hot" laboratory where radioactive materials are handled. Low humidity is required in these buildings for process control of ambient conditions, and a 500-ton system was installed. Air conditioning was installed only in laboratory working areas which require maintenance of uniform temperature and humidity conditions for operation of delicate instruments and control of experiments.

• **PARTICIPANTS.**—Engineering design and construction of the nuclear reactor at Brookhaven National Laboratory were carried out by The H. K. Ferguson Company of Cleveland and New York under supervision of Wells N. Thompson, vice president. Scientific specifications were established by the Brookhaven reactor staff, headed by Dr. Lyle B. Borst. The contract under which Brookhaven operates is supervised by Wilbur E. Kelley, manager of the New York Operations Office of the U. S. Atomic Energy Commission, and E. L. Van Horn, manager of AEC's Brookhaven area. The Babcock & Wilcox Company of Barberton, Ohio, served as engineering consultant in the final construction stages, along with David Rossheim and Addison G. Bissell, special consultants to the Atomic Energy Commission. The Servo-Mechanism Laboratory of the Massachusetts Institute of Technology of Cambridge, Massachusetts, designed and engineered the reactor control system.

• **SHAPING GRAPHITE.**—The unusual nature of the engineering and construction program carried out at Brookhaven by The H. K. Ferguson Company is indicated in a brief review of the work that went into the giant cube of graphite where the atomic reaction actually takes place. The cube is composed of 60,000 pieces of graphite, stacked one atop another, like building blocks. There are 2,600 different sizes and shapes of graphite, and an individual drawing was prepared by Ferguson's engineering department for each of the 2,600 variations.

The machining of graphite to tolerances of the order of thousandths of an inch was unusual in that it was the responsibility of the builder, rather than an outside supplier, to carry it out. It was desirable for security and other reasons to do this work on the job site, and it was accomplished by a Ferguson subcontractor, Liberty Products Company of Farmingdale, L. I., in a former Army gymnasium on the Brookhaven site which once housed Camp Upton. The gymnasium was equipped with a complex dust-collecting system to remove graphite dust and provide safe and satisfactory working conditions. Graphite and graphite dust are slippery by nature, and the removal of dust was necessary to prevent accidents.

Ferguson accomplished the "stacking" of graphite in the pile with its own forces. There is no bonding material between the individual blocks of graphite, and a highly complicated keying system, in which every piece is keyed either once or twice, became a part of the design. The lack of a bonding agent—which would have made the process unworkable—accounts in part for the close tolerances required to hold the structure together. Both external and internal forces also had to be compensated for in the design of graphite. External forces are strong due to the pressure drop required to provide the large volume of air used to cool the pile. Internal forces arise from the temperature differentials inside the graphite cube during the atomic reaction.

The actual stacking of graphite had to be done under conditions regarded as extraordinary in the construction industry. It was necessary to maintain security throughout the operation, and it was also necessary to prevent contamination of graphite. The principal contaminating agent guarded against was borax, an ingredient contained in most laundry soaps. Therefore, personnel stacking graphite were provided each day with a pair of white coveralls and gloves laundered with borax-free soap. They were also furnished basketball shoes to prevent slipping. Gloves were changed about six times daily to avoid accidents likely to result from accumulations of slippery graphite dust from the graphite blocks, some of which were about four feet in length and weighed up to 50 lb.

N. Y. BUILDING CODE

out for comment, to be adopted at local option.

The Technical Division of the New York State Building Code Commission on April 2 began analysis of comment and criticism received from recipients of the February 1 edition of the proposed State Building Construction Code applicable to one- and two-family dwellings, and of the Code Manual indicating methods and test procedures for alternate methods acceptable under the code.

• **REVIEW.**—The review edition of the proposed code and manual was mailed to officials of the 1,567 municipalities of the State, and to more than a thousand groups, including architectural and engineering societies, building trades unions and councils, contractors' associations, mortgage finance, and other business, trade and professional organizations.

Each recipient of the review edition was requested to submit commentary on the documents. In the case of architectural and engineering organizations, special code committees were appointed by the groups on a statewide basis to consider the code and manual and make comments representing the point of view of the associations.

The Commission will consider carefully all valid criticisms and suggestions. As the commentary is received it will be organized under applicable sections of the code and manual so that all matter pertaining to a given section may be considered together. After careful analysis of suggestions, changes will be made

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as the need for them appears. A special effort will be made to clarify the intent wherever public reaction indicates differences in interpretation.

• **ADOPTION.**—The State Building Construction Code, now in preparation, will be available not only to 339 municipalities of the State having building regulations, but to more than 1,200 other municipalities without regulations of their own.

The extension of the Commission's code, technical and consultative services to all municipalities, on an optional basis, results from amendments to the State Building Code Law passed at the recent session of the Legislature and signed by Governor Dewey on April 6.

Municipalities now may adopt the State code at will. A municipality may withdraw from the application of the State code at any time after one year elapses following its adoption by the municipality, and may, if it chooses, at any time thereafter restore the application.

As the law originally stood, the municipalities having building regulations were required to file formal objection to the applicability of the State code in their jurisdiction within 30 days of promulgation by the Commission or it would go into effect as an alternate to the local code. Once the State code went into effect in a municipality, the municipality lost its right to reject it at a later date.

• **TESTING PROCEDURES.**—Inquiries are being received by the State Building Code Commission regarding the acceptability of specific trade products under provisions of the proposed dwellings code. The Commission will be enabled to proceed toward consideration of product acceptances once the dwellings code is adopted in final form.

Under the Commission's plan, application for determination of acceptability of methods, materials, and equipment may be made by a party in interest. Supporting data, if available, will be asked for; if unavailable, the Technical Division in conference with the applicant will suggest a procedure by which the applicant may acquire such data from accredited sources.

If, in the judgment of the Technical Division, performance tests are required, the division will recommend that they be undertaken by the applicant. The Technical Division will make its recommendations to the Commission with respect to all applications. In the event that the subject material, equipment or technique meets, in the judgment of the Commission, the functional requirements of the code, it will be certified as acceptable, whatever qualification there be for acceptability being indicated in the certificate.

RECORD FIRST QUARTER

for plumbing and heating industry predicted before Penn. master plumbers.

Final figures on production and shipments of plumbing and heating products during the first quarter of 1951 will be larger than for any previous quarter, D. D. Couch, vice president and general manager of sales of American Radiator & Standard Sanitary Corp., predicted April 6.

Speaking before the 57th annual convention of the Pennsylvania Association of Master Plumbers, Mr. Couch also predicted that "industry production in the second, third and probably fourth quarters will be as much as 10 to 15% below first quarter accomplishments.

• **HOUSES UP.**—Dollar volume of residential construction contracts awarded in the first two months of 1951 was 35% higher than the corresponding period in 1950, Mr. Couch declared. "Total construction, excluding public works and utilities, was up 52.9% for the first two months this year versus the same period last year."

"Housing estimates for 1951 made last fall have been revised upward," Mr. Couch stated. "Conservative estimates are for 600,000 family units in the first half and an additional 350,000 in the second half—or a total of 950,000 family units for the year."

• **PRODUCTION UNEVEN.**—Production of plumbing and heating products during the year will be spotty and unbalanced, Mr. Couch believes. "There will be some products and some individual items which will not be available at all when present inventories are exhausted."

"On the other hand, those goods which can be produced are being manufactured at capacity rates and I believe that in the aggregate our industry will have enough production to make 1951 a profitable year."

In addition to his position as American-Standard vice president, Mr. Couch is a member of six industry advisory committees set up by the National Production Authority.

LOW-COST HEATING

for homes is object of Denver U. project sponsored by HHFA.

Highly efficient heating systems at a lower cost to the homeowner is the goal of a special study begun this week at the Institute of Industrial Research of the University of Denver, under sponsorship of the division of housing research for the Federal Housing and Home Finance Agency.

• **OBJECT.**—The project, to last a year, is designed to furnish data from which a national specification will be written by the government agency for low-cost, forced-air heating systems, Arthur M. Krill, project supervisor, said.

He explained that the housing agency was endeavoring to lower the over-all cost of the total house by reducing the cost of the component parts while protecting the consumer by increasing the quality. The DU project is concerned with developing less expensive air-moving equipment and in formulating standards for protection of the homeowner.

• **PROGRAM.**—The Institute will consolidate all known theories and information on heating systems; study fans, furnaces and duct characteristics in the labora-

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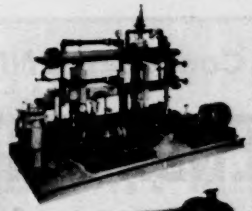

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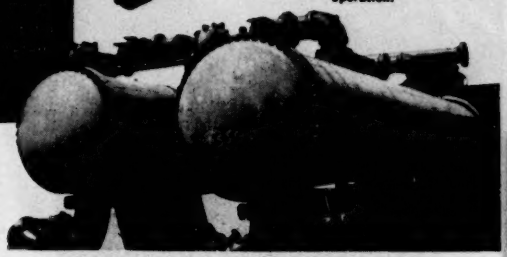

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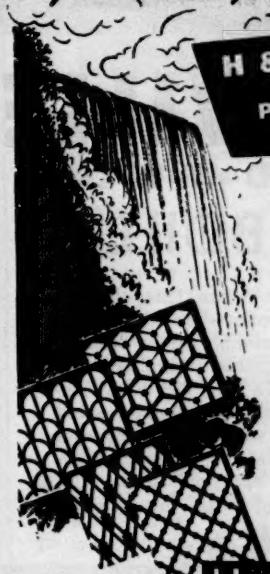

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tories; and will check systems in actual operation in numerous homes in Denver and Colorado.

Mr. Krill explained that there is no nationally accepted code on static-pressure requirements in forced-air heating systems, but some ordinances and specifications relating fan characteristics to duct requirements have been advanced by municipalities and national heating organizations.

• **PERSONNEL.**—Mr. Krill, a native of Longmont, Colo., and a graduate of the University of Colorado, was experimental engineer for Pratt and Whitney Aircraft Company before joining the DU faculty in 1947 as an assistant professor of mechanical engineering. He has also been a staff heating consultant for Bond Engineering Company of Denver.

MIDWEST POWER CONFERENCE

covers heat pump, cooling tower, and boiler deposit problems.

Among papers presented at the Midwest Power Conference, April 5 and 6, were four of special interest to heating and ventilating engineers. These papers dealt with heat pump ground coils, cooling towers, and fireside deposits in stoker-fired boilers. Abstracts of these papers follow.

• **HEAT PUMP.**—Influence of Freezing on Heat Pump Ground Coil Capacity, by A. D. Kafadar, and I. B. Fieldhouse, Research Engineers, Armour Research Foundation of Illinois Institute of Technology, and R. A. Budenholzer, Illinois Institute of Technology, pointed out that, since the largest potential market for the heat pump is the residential heating market, its success will depend to a large extent on its ability to compete with existing and more conventional methods of heating and cooling. Aside from the many advantages which the system offers to the customer, such as summer cooling without additional equipment, ease of operation, and cleanliness, it must nevertheless also compete favorably on an economic basis. In addition, the use of the heat pump can increase the natural resources of the nation.

It has been shown that a heat pump can be operated successfully on electrical energy and is able to compete with other fuels, even coal, when current can be purchased for two cents per kilowatt-hour. It can be operated with an engine-driven compressor in such a manner that about twice the heat now obtainable from a given fuel oil or gas can be delivered.

With such a promising future it might be asked why the heat pump is not widely used. The reason is that the problem of finding a suitable source of heat for the evaporator coils of the heat pump has been very difficult. Until a few years ago the only heat sources given consideration were outside air and well water. The former is unsuitable in the colder regions of the United States where the temperature often drops below freezing. The latter is suitable where available, but the large quantity of water required eliminates its use in many localities. Recently a great deal of attention

has centered around the possibility of using the ground as a source of heat and the results at present appear very favorable, especially for rural and suburban installations where a moderate amount of land is available for heat withdrawal.

However, there are still many engineering problems to be solved regarding the use of the earth as a source of heat. One of them is knowledge of the temperature distribution around a pipe buried in the ground for withdrawing heat. This knowledge is essential for predicting the coefficient of performance and capacity of a heat pump using the earth as the heat source.

As heat is withdrawn from the soil it is possible that the moisture in the soil surrounding the pipe will freeze. The effect of the freezing of moisture in the soil on the temperature distribution around a pipe when withdrawing heat at a constant rate from the surrounding earth is the subject of the present paper. This paper presents a method for predicting the radius to which the soil is frozen and for calculating the performance of a heat pump when freezing in the soil occurs.

• **COOLING TOWER WOOD.**—Recent Studies in Cooling Tower Wood Deterioration, by D. R. Baker, Engineering Research Division, The Marley Co., Kansas City, Mo., suggested that the economic significance of wood deterioration in cooling towers is best measured by installation costs. It is not uncommon for generating or processing units to require towers costing a quarter-million dollars or more, and as plant capacities increase so will expenditures for cooling equipment.

To protect these industrial investments, a continuing research program is delving into the causative factors of wood deterioration and methods of combating them. Donald R. Baker, research engineer, has devoted much time in this effort. He divides the common causes of decay into two primary classes: chemical action and fungus decay.

Mr. Baker draws an analogy between the action of alkaline solutions on cooling tower lumber and the common method of producing wood pulp for paper. In both instances removal of lignin (the natural binding element) frees the fibers that constitute the strength of wood. In cooling towers these alkalies and other injurious compounds may be inherent in natural water supply but are often introduced as treatment to prevent corrosion to metal.

Since the wood in cooling towers is often saturated with moisture half its own weight, it is a natural point of attack for airborne fungi.

Means of forestalling these costly processes of wood decay, while not specific, are in constant consideration. Conclusions derived from various experiments were outlined in Mr. Baker's speech.

• **COOLING WATER TREATMENT.**—Survey of Current Practice in Treatment of Cooling Water, by Durando Miller, technical department, The Permutit Co., New York, showed that in recent years increased attention has been focused upon treatment of industrial cooling water, due to shortages necessitating maximum reuse of water, and limited availability of alloys for cooling systems.

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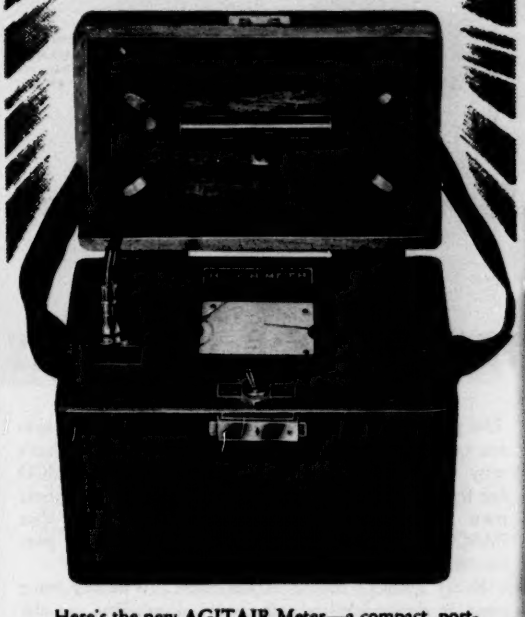

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As evaporation takes place, the minerals in the water remain behind and increase in concentration. Unless proper treatment is provided, hardness in the water coats heat exchange surfaces with scale which acts as an insulator and lowers efficiency. Water softening by either the zeolite or lime process is widely practiced to eliminate difficulties due to scale.

Prevention of all scale may introduce a different problem—corrosion due to oxygen from the air absorbed by the water in passing through the cooling tower. Copper and stainless steel alloys will resist such corrosion, but critical shortages of these materials during World War II forced many plants to use steel heat exchangers. Means were therefore perfected to protect the steel surfaces against corrosive attack.

One method consists of partially softening the water, and using the remaining hardness to form a thin scale acting as a barrier between the steel and the oxygen. Other methods involve use of chemical corrosion inhibitors or removal of air from the water.

Dirt and slime-forming organisms are as unpopular in cooling water as they are in drinking water, and are removed by methods similar to those used in municipal treating plants.

Water treatment engineers also give attention to the wood parts of the cooling tower, since they are susceptible to attack by highly alkaline waters, and also may experience rotting caused by fungus.

Many variable factors influence selection of cooling water treatment, such as type of water available, heat exchange materials, cooling tower performance, water temperatures and flow rates. Careful study of actual operating experiences at many plants using various treatment methods serves as a check on the theoretical calculations of the water treatment engineer.

• **BOILER DEPOSITS.**— Minimizing of Fireside Deposits in Stoker-Fired Boilers through Humidification of Combustion Air, by Paul Murphy, Jr., boiler room engineer, and John D. Piper, chemical supervisor, Research laboratory, The Detroit Edison Co., Detroit, sets forth a simple method for minimizing the rate at which fireside deposits form. This method consists of maintaining at least 16 pounds of water vapor per 1,000 pounds of air that is fed through the fuel bed.

Humidification is not new, and at least 40 patents have been issued since 1876 on introducing moisture either below or above the fuel bed for various purposes. However, as far as the authors of this paper are aware, this is the first instance where controlled humidification has been used for the specific purpose of reducing high temperature deposits on the heating surfaces of large stoker-fired steam generators.

Low absolute humidity periods result in rapid foul-

ing of the heating surfaces, increased flue-gas temperatures, increased fan-power requirements, increased clinkering of the fuel bed, and increased maintenance costs.

For many years it had been known that superheater deposits formed more rapidly in winter than in summer; and in 1949, the possibility of correlation was carefully analyzed.

The correlation was striking, and showed that the high humidity periods coincided with periods of low stack-gas temperatures and high efficiency.

There are days when the moisture in the combustion air, for a 325,000 lb per hr steaming rate, with 500 lb per hr and other days when the moisture was 7,470 lb per hr. If these amounts react quantitatively with the carbon as they pass through the fuel bed, the 500 lb will react with 1.35% and the 7,470 lb will react with 20.5%.

This difference suggests a possible water-gas reaction that could reduce the volatilization of various compounds from the fuel bed that condense on the heating surfaces of the boiler.

Steam was used to add moisture to the combustion air; control was manual, and the amount of moisture added was adjusted for each 25,000 lb per hr change in steaming rate, each 5% change in relative humidity and each 5-degree change in ambient temperature.

The first humidified boiler operated for a record of 133 days, and the stack gas temperature increased only 10F. The steaming capability of this boiler after 133 days of operation was still 400,000 lb per hr. The boiler was then shut down for two days for minor stoker repairs. No cleaning was done, and the boiler was put back into service and operated without benefit of humidification. After 29 days of operation, the steaming capability was reduced to 300,000 lb per hr and the stack gas temperature had increased 120F.

In order to determine the rate of deposition, the composition of the materials that adhere to the superheater, economizer, and air-preheater, a probe sampler was used.

Probe samples were taken while operating with varied quantities of humidification and under varied operating conditions. The results taken from these samples gave additional proof that humidification is beneficial.

The quantity of the deposit was lessened with the increase in humidity of the combustion air, and the color of the deposit ranged from nearly white for low humidity to nearly black with increased humidification.

INSULATION SYMPOSIUM

featured at ASTM spring meeting.

Widespread interest in thermal insulating materials and methods of evaluating their properties was evident in heavy attendance at the 1951 spring meeting of the American Society for Testing Materials in Cincinnati

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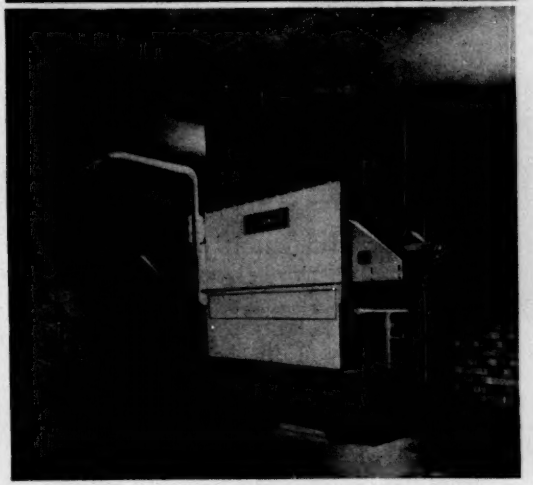

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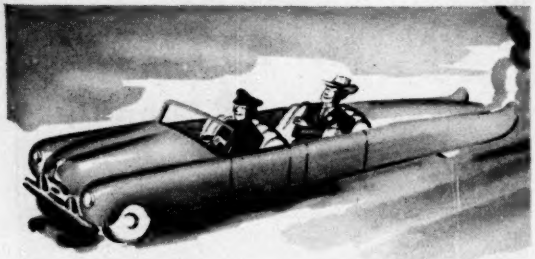

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which featured a five-paper symposium. This was sponsored by ASTM technical committee C-16 on thermal insulating materials. Ray Thomas, staff engineer, Union Carbide and Carbon Corp., past chairman of the committee, was responsible for developing the program. C. B. Bradley, a long-time member of the committee, representing Johns-Manville Corp., presided at the session which was held on March 7, in Cincinnati.

The Symposium on Thermal Insulating Materials consisted of the following papers:

Basic Concepts of Water Vapor Migration and Their Application to Frame Walls—F. A. Joy, Pennsylvania State College.

Appropriate Methods for Measurement of Surface Emittance—L. P. Herrington, John B. Pierce Foundation.

The Measurement and Significance of Specific Heat of Thermal Insulating Materials—Norman H. Spear, John B. Pierce Foundation.

A Comparison of Thermal Conductivity Determination Made on 18 Different Guarded Hot-Plate Apparatus—H. E. Robinson, National Bureau of Standards.

Experiments With a Guarded Hot Plate Thermal Conductivity Set—Charles F. Gilbo, Armstrong Cork Co.

• **MOISTURE.**—Professor Joy pointed out that excessive moisture in the walls of frame dwellings is not a new condition but its prevalence increases as modern homes are built smaller and tighter. The source is usually within the house itself, a typical family producing around 700 lb of water vapor per month.

The behavior of water vapor is well understood by engineers, but we are puzzled to explain some moisture phenomena; and while the relation that vapor resistance (the reciprocal of permeance) is proportional to specimen thickness is doubted by some, all data we have taken reasonably confirm it.

The propriety of adding the vapor resistances of its parts to get the resistance of a combination has sometimes been questioned but this is manifestly correct in theory, and all our tests confirm it. One such test—apparently contradictory, but actually confirmatory—is cited wherein a composite panel passed 4 times as much vapor in one direction as the other with no change of the exposure conditions.

One more misconception of vapor transfer relates to the mechanism of movement in air-filled spaces. Convection of air, rather than diffusion of vapor, is the important factor. This conclusion finds important application in the air spaces of walls, especially regarding leakage through small holes and cracks in barriers.

Vapor control measures include: (1) place a vapor barrier on the warm side of the wall; (2) ventilate the house; and (3) ventilate the wall itself. The first measure has been endorsed by all authorities, but the effectiveness of certain barrier types can be destroyed by installation that is only a little short of perfect. This raises a question if such barriers are really practical. The second measure is obvious and indeed must accompany the first. The third is not widely accepted but may be the logical one in certain cases. A fourth

measure, choice of a "breathing type" or high permeance sheathing paper has been generally recommended, as a companion to a vapor barrier, but our experience does not indicate the importance of high or low permeance when a barrier is installed, Prof. Joy stated.

• **SURFACES.**—Dr. Herrington stated that there is much current interest in the measurement of infrared heat emission and absorption of structural materials. He reviewed the terminology of radiation exchange from the standpoint of simplicity and usefulness in a standardized test suitable for use with structural materials as non-incandescent temperature radiators. Finally he described an apparatus construction for surface emittance measurement in the 0 to 300F range.

• **SPECIFIC HEAT.**—Primary problems in the practical field were discussed by Mr. Spear in his paper on specific heat, in terms of a number of illustrative examples. These include an analysis of the effect of specific heat on the performance of building structures subject to different diurnal and seasonal temperature cycles, a consideration of pipe insulation practice, and a review of recent work in engineering properties of protective clothing.

• **CONDUCTIVITY.**—Mr. Robinson detailed a program of comparative thermal conductivity tests made on corkboard at a mean temperature from 20 to 120F with 18 different guarded hot-plates conforming to ASTM Methods C 177 — 45 in 16 different laboratories. Examples of results in good and poor agreement were presented and discussed, and a diagram was given showing the frequency distribution of average per cent temperatures for each apparatus from results obtained.

• **HOT PLATE.**—The experiments covered by Mr. Gilbo show that hot plates, as presently constructed, probably do not possess a sufficiently accurate temperature control on the guard heater and that extremely small amounts of unbalance affect the thermal conductivity results more than had previously been supposed. It is also demonstrated that the ambient temperature, when allowed to rise above the hot plate temperature, markedly influences the results.

• **PROPOSALS.**—The effect of moisture on thermal conductivity has long been of concern to the users and producers of thermal insulating materials. ASTM Committee C-16, at its meetings in Cincinnati on March 6 to 8, outlined an extensive research project to study this problem.

Several new test methods were recommended for letter ballot approval, including one for determining density of preformed block insulation, density of preformed pipe insulation, and blanket type pipe insulation. In addition, a new specification for molded type mineral wool pipe insulation for elevated temperature and a tentative definition of the term "structural insulation board" were recommended.

Other proposed standards being developed include a sampling procedure for block and pipe insulation; specification for diatomaceous earth insulation; a linear expansion test method on insulating board, using Forest Products Laboratory apparatus; and a method of test for determining adhesion of dried thermal insulating cement. Cooperative tests to evaluate a new

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Multiple Deflection Air Conditioning

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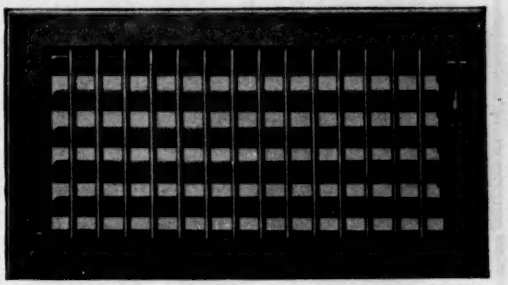
for High Velocity Outlets



No. 1005 V-HML. Single bank of adjustable bars, multi-louver valve.

For beauty, efficiency, and flexibility in modern air conditioning, ventilating, and cooling systems—get Auer Streamliners. In these highly perfected registers and grilles, the bars are hollow molded, beveled, carefully formed, smooth in contour. Each bar is pivoted in frame on special split sleeves, or "expansion" inserts, furnishing proper tension to hold bar firmly in position (and maintain silence when register is in operation at high velocity) yet readily adjustable to any desired angle. Bars have "tear-drop" shape in cross-section, somewhat like an airplane wing, and being pivoted at the exact center, may be completely reversed. This permits you to turn the *thin* edge outward, if you wish (and the *broader* edge toward air-flow), cutting resistance and turbulence to the minimum. Bars may be set in any grouping, and repeated adjustments are not likely to affect their rigidity when set. Shutters of multi-louver control valves are pivoted on rivets to prevent any vibration. All Streamliner registers equipped with gaskets. Write for Folder S-50 with sizes and prices.

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No. 1005 V-HML. Register with single bank of vertical bars, and multi-louver valve.
No. 1005 H-HML. Register with single bank of horizontal bars and multi-louver valve.
No. 1205 VH. Grille only, with double bank of bars, front vertical, rear horizontal.
No. 1205 HV. Grille only, with double bank of bars, front horizontal, rear vertical.
No. 1205 VH-HML. Register with double bank of bars, front vertical, rear horizontal, and multi-louver valve.
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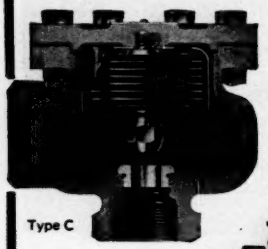
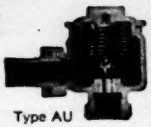


Type C



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method for measuring plasticity of insulating cement at any water-cement ratio, and round-robin tests to establish the maximum rise in temperature limits in measuring specific heat are under way.

It was announced that three proposed new specifications had received a satisfactory vote and will be presented to the society for approval. These specifications cover mineral wool felt insulation, mineral wool industrial batt insulation, and mineral wool blanket insulation (metal mesh cover).

A statement on combustibility as well as a test method is being developed for blanket insulation.

Committee C-16 selected Skytop, Pa., as the place for its 1951 fall meeting, which will be held in October. Officers of Committee C-16 are: Chairman, E. R. Queer, Pennsylvania State College, State College, Pa.; secretary, H. G. Hill, Ehret Magnesia Manufacturing Co., New York, N. Y.

• New cargo ships to be called Mariners will be successors to the Liberty and Victory ships built during World War II. These 20-knot vessels are designed for service without convoy in forward areas and will be equipped with helicopters to fight off submarines. Congress voted $350 million for the program. Some launchings are expected this year.

Getting Personal

George R. Wachter (co-author of *Year-Round Air Conditioning for Residences*, page 87) is currently manager of sales engineering, York Corp. He has been with this company ever since his graduation from The Pennsylvania State College in 1935 with B.S. and M.S. degrees in mechanical engineering.

Mr. Wachter has had considerable experience with commercial air conditioning applications, low temperature refrigeration, and centrifugal air conditioning and refrigeration equipment.

G. R. Wachter

C. M. Gerhart

C. M. Gerhart (co-author of *Year-Round Air Conditioning for Residences*, page 87), a sales engineer for York Corp., is a native of Roseville, Calif. A little more than a year ago he was transferred from the Houston, Tex., office of the company where he served as assistant to the commercial sales manager, to York, Pa. He has a thorough background in residential air conditioning.

He is an M.E. graduate of the University of Arizona, class of 1946. His college work was interrupted by a hitch in the Army Air Corps during World War II. When mustered out he was a First Lieutenant. In 1946 he enrolled in York Corporation's College Graduate Training Course, and later served in company offices at Los Angeles, Calif., Houston, Tex., and York, Pa.

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A. H. Gipson

Allen H. Gipson *(Heat Exchangers Reduce Air Conditioning Costs,* page 71) has charge of factory planning in the air conditioned plant of Western Electric Co., Allentown, Pa. A continuing investigation to keep down operating costs to an absolute minimum has produced several interesting developments of which one is described in his article.

His activity has ranged from machine shop foreman to real estate operator, and from assistant sales manager for a building materials manufacturer to the operator of a furniture manufacturing venture. Ten years ago he became affiliated with Western Electric in factory planning. Not easily rooted, he has already worked in four of the company plants.

During World War II he acquired five campaign ribbons with eight battle stars for naval actions.

INDUSTRIAL DEGREE-DAYS
March, 1951

City	55F Base	45F Base
Baltimore, Md.	308	76
Buffalo, N. Y.	608	324
Chicago, Ill.	597	312
Cleveland, Ohio	522	253
Detroit, Mich.	570	288
Indianapolis, Ind.	529	261
New York, N. Y.	411	129
Philadelphia, Pa.	358	103
Pittsburgh, Pa.	409	165
St. Louis, Mo.	438	188

Canadian Degree-Days for March, 1951*

City	March		Cumulative Sept. 1 to Mar. 31	
	1951	Normal	1950-51	Normal
Calgary, Alta.	1600	1215	8850	7881
Charlottetown, P.E.I.	1079	1203	6152	6869
Crescent Valley, B. C.	1097	961	6546	6704
Edmonton, Alta.	1673	1290	9542	8589
Fort William, Ont.	1451	1386	8978	8590
Grande Prairie, Alta.	1739	1339	10383	8795
Halifax, N. S.	943	1066	5224	6134
London, Ont.	1004	1073	6281	6326
Medicine Hat, Alta.	1631	1150	8519	7588
Moncton, N. B.	1110	1190	6461	7296
Montreal, P. Q.	1081	1265	6245	7373
North Bay, Ont.	1271	1280	8034	7933
Ottawa, Ont.	1134	1256	7205	7638
Penticton, B. C.	986	787	5591	5566
Porquis Junction, Ont.	1438	1550	9355	9614
Prince George, B. C.	1383	1091	8746	7768
Quebec City, P. Q.	1178	1311	7147	7999
Regina, Sask.	1906	1504	10275	9641
St. John, N. B.	1004	1132	5980	6784
Saskatoon, Sask.	1891	1445	10511	9356
Toronto, Ont.	939	1072	5586	6226
Vancouver, B. C.	837	682	4572	4479
Victoria, B. C.	767	651	4306	4065
Windsor, Ont.	924	995	5762	5872
Winnipeg, Man.	1582	1531	9553	9622

*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.
The Department reports a slight revision in the figures for February as published in last month's issue. Corrected figures are: Calgary, Alta., 1462; Prince George, B. C., 1462.

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PACKING, molded rings of graphited, wire-inserted asbestos designed for high pressure service.

PLUG TYPE DISC, nickel copper alloy, has extra wide seating surfaces for precise throttling control . . . is exceptionally resistant to scouring or wire drawing.

RENEWABLE SEAT RING, nickel copper alloy, ground to match disc in each valve to assure full bearing surfaces over entire contact area of each.

KENNEDY Fig. 544P, plug type disc, and Fig. 544, full-way disc, are designed for 300 lbs. s.eam, 600 lbs. WOG. Fig. 138P, plug type, and Fig. 138, full-way disc, for 200 lbs. steam, 400 lbs. WOG.

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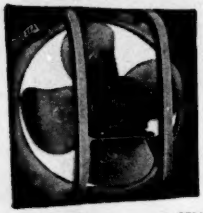

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COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

COMFORT CONFERENCE—The Fort Wayne Indoor Comfort Conference, sponsored by the National Warm Air Heating and Air Conditioning Association, at the Chatterbox of the Hotel Van Orman, Fort Wayne, Ind. William Noel Buck, chairman of the Conference, Fort Wayne Air Conditioning Co., California Rd., Fort Wayne 8, Ind. .....**MAY 25-26, 1951.**

ASRE MEETING—Spring meeting of the American Society of Refrigerating Engineers, at Hotel Statler, Detroit, Mich. M. C. Turpin, secretary, 40 West 40th St., New York 18, N. Y. .....**MAY 27-30, 1951.**

AUTOMOTIVE ENGINEERS MEETING— 1951 summer meeting of the Society of Automotive Engineers, at the French Lick Springs Hotel, French Lick, Ind. John A. C. Warner, secretary of the Society, 29 West 39th St., New York 18, N. Y. ..... **JUNE 3-8, 1951.**

NDHA MEETING—42nd annual meeting of the National District Heating Association, at the Statler Hotel, Detroit, Mich. John F. Collins, Jr., secretary-treasurer of the Association, 827 N. Euclid Ave., Pittsburgh 6, Pa.....**JUNE 5-8, 1951.**

ASME MEETING—Semi-annual meeting of the American Society of Mechanical Engineers, at Hotel Royal York, Toronto, Ont., Canada. C. E. Davies, secretary of the Society, 29 West 39th St., New York, N. Y. .....**JUNE 11-15, 1951.**

TESTING MATERIALS MEETING — Annual meeting of the American Society for Testing Materials, at the Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. .....**JUNE 18-22, 1951.**

STOKER MEETING — 1951 annual meeting of the Stoker Manufacturers Association, at South Shore Inn, Lake Wawasee, Syracuse, Ind. Marc G. Bluth, executive secretary of the Association, 307 North Michigan Avenue, Chicago 1, Illinois. .....**JUNE 25-26, 1951.**

ELECTRICAL ENGINEERS MEETING—Summer general meeting of the American Institute of Electrical Engineers, at Royal York Hotel, Toronto, Ont., Canada. Secretary of the Institute, 33 West 39th St., New York 18, N. Y. .....**JUNE 25-29, 1951.**

ASHVE MEETING—Semi-annual meeting of the American Society of Heating and Ventilating Engineers, at the Hotel Multnomah, Portland, Ore. A. V. Hutchinson, executive secretary of the Society, 51 Madison Ave., New York 10, N. Y. .....**JULY 2-4, 1951.**

REFRIGERATION CONGRESS—Eighth International Congress of Refrigeration, under the auspices of The International Institute of Refrigeration, to be held at Church House, Westminster, London, England. The Secretary, Dalmeny House, Monument St., London, E. C. 3. .....**AUGUST 29—SEPTEMBER 11, 1951.**

INSTRUMENT CONFERENCE AND EXHIBIT—1951 Instrument conference and national exhibit of the Instrument Society of America, at the Coliseum, Houston, Tex. John McCaffery, assistant executive secretary of the Society, 921 Ridge Ave., Pittsburgh 12, Pa. .....**SEPTEMBER 10-14, 1951.**

ASME MEETING—Fall meeting of the American Society of Mechanical Engineers, at the Radisson Hotel, Minneapolis, Minn. C. E. Davies, secretary of the Society, 29 West 39th St., New York 18, N. Y. .....**SEPTEMBER 25-28, 1951.**

PLUMBING AND HEATING MEETING—Annual meeting of the Plumbing and Heating Industries Bureau, at Palmer House, Chicago, Ill. Norman J. Radder, secretary of the Bureau, 35 East Wacker Drive, Chicago 1, Ill. .....**OCTOBER 11, 1951.**

AGA CONVENTION—33rd annual convention of the American Gas Association, at Kiel Auditorium, St. Louis, Mo. Secretary of the Association, 420 Lexington Avenue, New York 17, N. Y. .....**OCTOBER 15-17, 1951.**

PUBLIC HEALTH MEETING — 79th annual meeting of the American Public Health Association, at Civic Auditorium, San Francisco, Calif. Willimina Rayne Walsh, associate secretary of the Association, 1790 Broadway, New York 19, N. Y. .....**OCTOBER 29—NOVEMBER 2, 1951.**

REFRIGERATION SHOW—7th All-Industry Refrigeration and Air Conditioning Exposition, at Navy Pier, Chicago, Ill. Show director, REMA 1346 Connecticut Ave., N.W., Washington, D. C. .....**NOVEMBER 5-8, 1951.**

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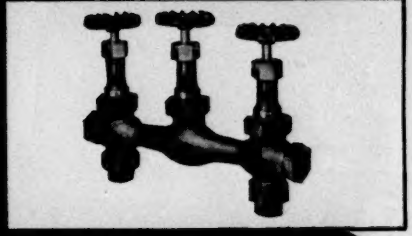

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Z-CRETE COSTS LESS to install because it is monolithically poured right on the job—no joints, no voids. Special provisions for drainage or ventilating are not usually required. Any size or arrangement of pipes may be quickly and economically insulated with Z-CRETE. There is a licensed Z-CRETE applicator in your locality. Write us and we'll put him in touch with you without obligation.

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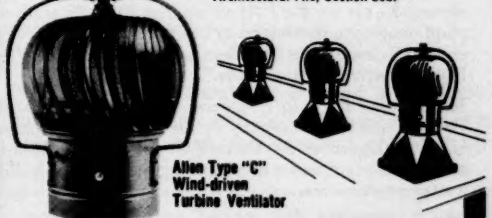

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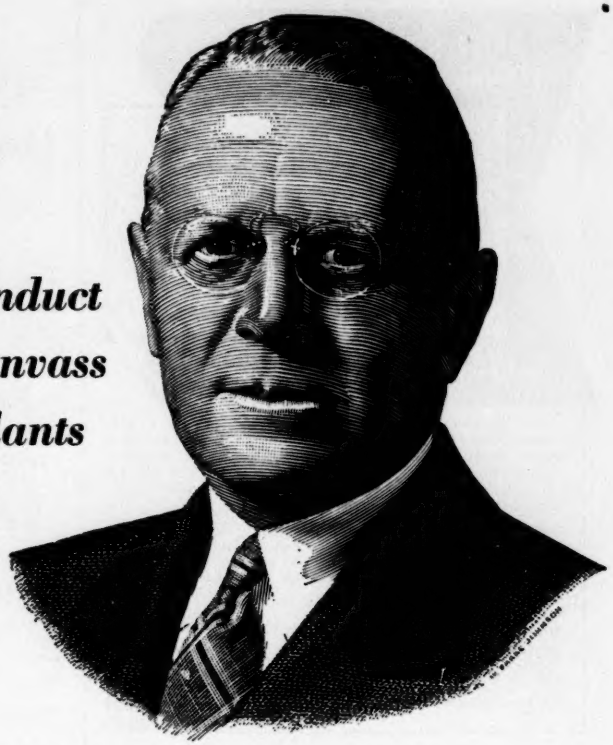

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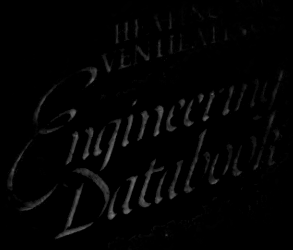

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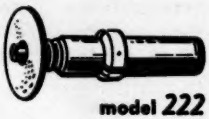

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1 Water under 212° F. contains no energy.

2 Water cannot get hotter than 212° F. unless it is under pressure.

3

Water under **30 lbs**	pressure boils at	**274° F**
Water under **50 lbs**	pressure boils at	**297° F**
Water under **70 lbs**	pressure boils at	**316° F**
Water under **90 lbs**	pressure boils at	**331° F**

4 The energy liberated at only 50 lbs. pressure, where the water boils at 297°, is equal to more than 2 lbs. of Dynamite. The higher the pressure, the higher the possible temperature, the higher the energy.

5 Every system must operate under pressure; therefore the temperature can become critical (above 212°). Even if the normal pressure is only 70 lbs. the temperature can reach 316° F. — that's 104° too hot —

That's Dynamite

6 A tank that safely holds 100 lbs. pressure with water below 212° may not be safe at the same pressure when the water is superheated because of heat weakening. An old tank is always weaker than a new tank, but heat places an additional stress upon any tank.

7 Domestic hot water was meant to be used as water — not steam — therefore it should never be allowed to exceed 212° F

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AIR CONDITIONING DESIGN CONDITIONS - COMMERCIAL BUILDINGS

(Abstracted from a report by Walter T. Ringer, Assistant Editor, Heating and Ventilating)

Banks

Enclosed air conditioning systems are commonly employed for about 75 percent of banking offices. The central system is installed in the larger city banks. An effort is made to maintain 75 to 78F comfortable interior health and outside temperatures, and to hold the relative humidity at 40 to 50%. Cleanable air filters are favored.

Baked Goods Stores

According to one bakery authority, there are very few air conditioning installations in retail bakery establishments.

The higher humidity resulting from the washed air has a somewhat deleterious effect on the retail type of bakery product—the crisp crust of freshly baked bread, pies and sweet goods is lost. In addition, fancy cakes do not hold up well if subjected to moisture.

All this would be different were bakers educated to the possibilities of a dehumidifier.

Where air conditioning is employed, it is chiefly to relieve the morale of the salespeople, and the following design conditions are common: Temperatures between 76 to 80F and relative humidity between the limits of 45% and 60%.

Barber Shops

Since this operation culminates on the long 4-day cycle generally air conditioned. To meet travel standards established for coach travel on many railroads, an increasing number of air conditioned motor coaches or buses are being placed in service for the long runs.

While some of the modern bus air conditioning systems have very elaborate temperature control equipment, operated with a definite differential on optimum outside conditions, and even employing odorant and humidity control, other buses are nothing more than a simple thermostat for turning the air conditioning system on or off. It is believed that neither of these two systems is thoroughly satisfactory. The elaborate system is too complicated and too costly and also is too prone to give trouble. The simple system has the characteristic humidity rise during the off periods. However, the trend is toward greater simplification of controls.

It is difficult to set comfort standards for motor coach air conditioning for, due to the sun effect through windows, the proper answer has not been found. As compared with conventional stationary practice, the perfect air distribution system has not been found.

In order to establish definite design conditions, it is said to employ inside design optimum conditions of 76 to 78F D.B., and from 50 to 60% R.H.

It is not advisable to establish specific inside-outside temperature conditions because of changes in outside and the resulting apparent loss in passenger comfort.

Due to heat radiation from a sun-heated pavement, the outside temperature will be about 15F higher than the shade value; in addition the cooling unit must operate to the heat equivalent of the sunlight.

Dental Offices

Air conditioning in dental offices not only provides the comfort of the patient, but it improves the efficiency of the dental operators. Temperature, temperature and humidity conditions greatly assist in the disinfection method found the simplest many of dental operations.

Several materials that are commonly used, such as fine white cements, silicates, and certain impression materials, are more or less affected by temperature and humidity conditions in their manipulation. Air conditioning stabilizes the behavior of troublesome materials.

In lieu of more specific information, design conditions may be considered as 75F and 50% R.H.

Department Stores

Research and practical experience has long established that the conditions most satisfactory to both customer and employee is 76 to 80F dry bulb, relative humidity of 50%. Temperatures above 80F have not been satisfactory, while higher humidities tend to make odors noticeable and to make necessary a greater amount of outdoor air for odor dilution. The low air temperature is not desirable, for it is no longer necessary to impress customers with the fact that the store is air conditioned.

Comfort should not be stressed to the customer; rather, the customer should be unaware that the air conditioning system exists. The paramount thing is to have a system that functions—one that is definitely not uncomfortable in its results.

In department stores, it is impossible to have the temperature indoors change in the same degree as the outdoor temperature. The heat storage of the building simply does not follow the conditions exactly. It is far more desirable to hold a temperature or a point that will prevent customers from perspiring. The actual temperature should be merely an assumption, of one extent, that the plant is sealed.

Hospitals

Air conditioned space in hospitals is generally confined to the operating room, recovery room, and labor and delivery rooms of the maternity ward. Air conditioning has been used in rooms for the treatment of certain infants, treatment of fevers, and a number of chronic ills are common during periods of hot weather.

The operating room is the one that is most generally air conditioned. For this and also for the labor room,

temperature is from 78 to 80F and relative humidity from 55 to 60%. The high relative humidity is necessary to eliminate possible explosions due to anesthetic gases. Because of this high relative humidity, steps must be taken to prevent condensation and frosting on windows during cold weather.

Nothing more than ordinary filtering is practiced because ordinances in some cities prohibit air recirculation. However, activated carbon has been helpful in removing odors and traces of anesthesia gases.

Libraries

Record material in libraries such as paper, leather, cloth, thread and adhesives are susceptible to decay brought about by unfavorable conditions of temperature and humidity. Extreme dryness makes these materials so brittle that books and manuscripts show signs of repeated handling. Paper, cotton and leather, under certain conditions, are subject to mildew which propagates by spores nearly always present in air. These grow slowly below 40F and very rapidly at the optimum temperature which varies with the species of growth. Since an abundance of water is required for their growth, if the relative humidity is kept below 80%, paper, cotton and leather will not contain enough moisture for such growth, but glue and starch will still be susceptible. Therefore, if these materials are protected in the bookbinding process by adding a bactericide such as betanaphthol, mildew will not form.

It is fortunate that air conditions for personal comfort are similar to air conditions favorable for the storage of records and books in libraries. Suitable values are: summer temperature, 80F; winter temperature, 70F; relative humidity, 40-50%. However, in extremely cold weather, a lower relative humidity is necessary to prevent moisture condensation on windows. Under the conditions stated, the strength and flexibility of record materials are not adversely affected, and growth of molds and fungi is inhibited.

Motion Picture Theaters

The accepted standard for air conditioning motion picture theaters is to maintain summer conditions of 78-80F and 50% R.H., based on an outside temperature of 95F. However, in the South it is held at 80F, while in Cuba, for example, it is 85F.

More than anything else, excessive relative humidity will lessen the sensation of comfort of occupants seated in the theater. While it is expected that the next advance in theater air conditioning will be the development of an independent means for dehumidification, at present reduction in humidity is obtained by lowering the temperature of the air supply to a point required for theater cooling, and then to raise the temperature of air leaving the cooling coil by using the heat in the return air from the theater, or by depending on steam reheating coils.

Tests have shown that the desired differential between inside and outside temperatures should be from 12 to 15F. Some theaters have inside-outside controls.

Clean air is considered desirable to protect theater furnishings and decorations and also from the health standpoint. While electrostatic filters are considered best, they are also the costliest type of air filter. Types generally used are the throwaway type or those that can be washed and reused again. Most operators consider filters an operating nuisance. Where the air conditioning system employs washers, the washers are relied upon to remove dirt from the supply air.

Passenger Cars for Railroads

Temperatures generally maintained in passenger railroad cars during day periods is 76F and at night, 72F; the approximate relative humidity both times is 48%. These conditions are maintained during normal summer operation with outside temperatures of 95F D.B. and 75F W.B.

The air conditioning unit is located beneath the roof at one end of the car. Here fresh air is drawn into the blowers through air filters where it is cleaned of all foreign matter. The air then passes through coils, and after the air is cooled it is distributed in the car space.

Photographic Studios

Both personal comfort and industrial air conditioning must be considered in the design of commercial photographic studios. The studio proper, dressing rooms, and offices are maintained at 74F and 30 to 40% R.H., as listed in Table 1.

In the printing and developing rooms, not only must air conditions be controlled, but it is desirable to maintain developing solutions and rinse water at proper temperatures, for the time of development and the quality of the final product is directly related to a controlled solution and wash-water temperature. Heat is liberated during the printing, enlarging and drying processes and this must be removed. Controlled conditions are also necessary for the storage of photosensitive materials such as film and paper.

TABLE 1—DESIGN CONDITIONS FOR COMMERCIAL PHOTOGRAPHIC STUDIOS

Room or Process	Temperature, F	Relative Humidity, %
Studio, dressing rooms and offices	74	30-40
Developing of film	70-75	60
Film drying	75-80	50
Printing	70	70
Cutting	72	65
Film and paper storage	60	45

(To be concluded)

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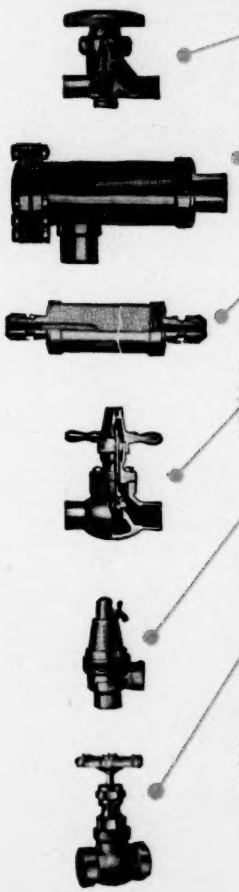

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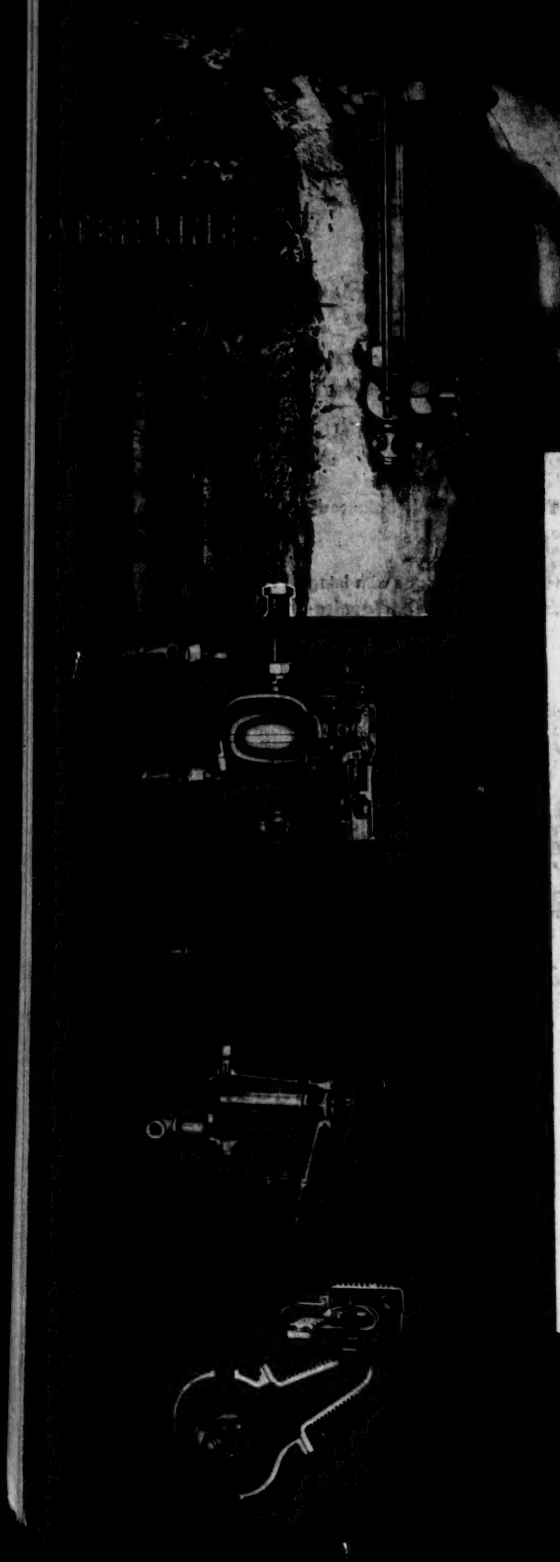

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